A star (*) *indicates that the Abstract deals with Apparatus and Instruments.*

MARCH, 1936.

GENERAL PHYSICS.

ADSORPTION.

919. "Apparent" and "True" Adsorption Functions. K. S. G. Doss and B. S. Rao. *Mysore Univ. J.* 8. *pp.* 49–61, *Jan.*, 1935.—The assumptions underlying the derivation of the Ostwald-Bartell expression for "apparent adsorption" are shown to be unsound. "Apparent adsorption" is shown to be a measure of Gibbs' adsorption excess and is thus more significant than "true adsorption." The nature of the two typical "S" and "U" shaped adsorption curves obtained with pyridine-water and alcohol-carbon tetrachloride mixtures is discussed. The specific surface of silica gel is calculated by a new method involving data on selective adsorption. AUTHORS.

920. Sorption of Hydrogen and Deuterium by Copper and Palladium. Parts I and II. H. W. Melville and E. K. Rideal. *Roy. Soc., Proc.* 153*A*. *pp.* 77–103, *Dec.* 2, 1935.—In Part I the following heterogeneous reactions of H_2 and D_2 are investigated with these results: CuO is reduced by atomic H and D at 20° C. at the same velocity. This is in agreement with previous experiments showing that free atoms of H and of D react at identical velocities. CuO is more rapidly reduced by H_2 than by D_2 at 156–269° C. The difference in energy of activation is 0·4 k. cal. This is also in agreement with the observation that H_2 reduces simple molecules on a metal (nickel) surface more quickly than D_2. H_2 and D_2 are sorbed by and desorbed from Cu at the same velocity at temperatures from 71° to 200° C., except that at higher temperatures H_2 is sorbed slightly more quickly. In Part II the diffusion of H_2 and of D_2 through Pd, Cu and Ni is investigated at temperatures from 150 to 350° C. and at pressures from 1 to 200 mm. For each metal H_2 diffuses more quickly, the difference in energy of activation for diffusion being 0·8 for Pd, 0·6 for Ni, and 0·8 k. cal. for Cu respectively. The Cu and Ni are supported on Pd. In Cu, it is shown by employing composite films Cu–Pd–Cu and Pd–Cu–Pd that the rate-determining step, and therefore the step responsible for the difference in the velocity of diffusion, is not due to any process connected with the gas metal interface. With Pd measurements of the solubility of the two isotopes are also made, H_2 being the most soluble. Combining these results with the diffusion measurements it is shown that the difference in velocities of diffusion is due partly to the greater solubility as well as to the greater mobility of H_2 in Pd. Potential barriers are constructed from diffusion and solubility data, and it is shown that there exists a definite barrier for the penetration of H_2 from the surface to the interior. The barrier has the same height for both H_2 and D_2 and a mechanism for the transfer of gas is suggested. AUTHORS.

921. Dissociation Equilibrium of Hydrogen and its Adsorption on Tungsten. J. K. Roberts. *Cambridge Phil. Soc., Proc.* 32. *pp.* 152–157, *Jan.*, 1936.—The various processes occurring at the surface when H_2 is adsorbed on W are considered together with the dissociation equilibrium of H_2 in the gas phase. The form of the adsorption isotherm is deduced from the principle of detailed balancing and is in agreement with that obtained by Fowler using a statistical method. A detailed interpretation of the experimental results now available shows that either (*a*) measurements of the rate of removal of the adsorbed film of O_2 on W do not measure the rate of evaporation of O atoms or (*b*) it is not possible to obtain a general first approximation formula giving the rate of evaporation of adsorbed atoms in terms of the heat of desorption. The desorption of H_2 from W is discussed and it is shown that the agreement between the temperature at which the film evaporates at an appreciable rate and that deduced from a desorption formula of the type mentioned in (*b*) assuming that the H_2 evaporates as atoms must at present be regarded as a coincidence. AUTHOR.

***922. Chemisorption on Charcoal. Adsorption of Water Vapour. C. G. Lawson.** *Faraday Soc., Trans.* 32. *pp.* 473–478, *Feb.*, 1936.—A sorption balance is designed to measure adsorption isotherms of water on charcoal covered with various surface oxides, small quantities of desorbed gases being continuously removed. Adsorption isotherms are measured for a series of charcoals activated at different temperatures. The mean time of sojourn of water molecules on the surface of charcoal is increased by the presence of the surface oxide formed at about 400° C., and decreased by the surface oxide formed at high temperatures. The extent of hysteresis is measured in the case of two charcoals. When ash is present in charcoal there may be chemisorption of water; this is not noticed with ash-free charcoal. The adsorption of water on graphite is found to be of the same general type as on charcoal; the hypothesis of capillary condensation does not give a simple explanation of this fact. AUTHOR.

923. Adsorption Isotherm of Heavy Water on Charcoal. A. King and C. G. Lawson. *Faraday Soc., Trans.* 32. *pp.* 478–481, *Feb.*, 1936.—The fractionation of D_2O by selective adsorption on charcoal and silica gel shows that on progressive desorption of water from charcoal, the proportion of D_2O becomes greater until the final fraction contains about 1·4 times the amount of D_2O in the original water. This is attributed to differences in the mutual polarisabilities of the two species, leading to different rates of desorption, and an attempt is made to test this hypothesis by measuring the adsorption isotherm for D_2O on charcoal previously baked out *in vacuo*, as well as a comparison isotherm for H_2O under the same conditions. The isotherms obtained are very similar for H_2O and D_2O. N. M. B.

924. Detergency of Soap Solutions. B. G. Acharya and T. S. Wheeler. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 637–645, *Dec.*, 1935.—A method is described for measuring the adsorption of soap by cotton under standard conditions. Evidence is brought forward to show that the adsorption figure may be a measure of the detergent action of soap solutions. AUTHORS.

925. Sorption of Lime by Cellulose and Wood. G. L. Larocque and O. Maass. *Canad. J. of Research*, 13. *Sect. B. pp.* 380–383, *Dec.*, 1935.—The adsorption of lime on cellulose and wood is measured. On the basis of molecular proportions, the magnitude of the adsorption is shown to be much greater than that of sodium hydroxide. It is found that considerable time is required for saturation adsorption to take place. The adsorption on similar wood species is shown to be the same and much greater than on cotton cellulose. AUTHORS.

926. Heat of Wetting and the Rodewald Equation. P. J. Andrianow. *Kolloid Zeits.* 73. *pp.* 328–334, *Dec.*, 1935.—Rodewald's equation which sets out the dependence of the heat of wetting on the dampness of the powders is examined and the physical meaning of its constants is ascertained. J. K.

927. Disperse Wetting Hysteresis. I. R. Kljatschko. *Kolloid Zeits.* 74. *pp.* 90–97, *Jan.*, 1936.—The hysteresis of disperse wetting is considered and a method of measurement is given. Disperse wetting-hysteresis isotherms are given for various minerals. The results show that the disperse wetting hysteresis is considerably greater than the usual kinetic hysteresis, and that the isotherms, in contrast to their usual behaviour, lie nearly completely in hydrophobic regions. The disperse wetting hysteresis depends very largely on the adsorption of surface active bodies, and often it produces a greater hydrophobic action than the adsorption. A relation between disperse hysteresis and flotation is established. P. H. B.

928. Maximum Adsorption. Part I. H. Brintzinger, A. Schall and H. G. Beier. *Kolloid Zeits.* 74. *pp.* 29–32, *Jan.*, 1936.—Maximum adsorption is defined as the amount of substance adsorbed at a given temperature by 1 gm. of the adsorber from a saturated solution of the substance. Its value for various forms of active carbon is determined in the cases of salicylic acid and quinine. Most forms adsorb the former better than the latter ; at 30° C. the best samples of active carbon adsorb up to 92 % of their weight of either. J. S. G. T.

929. Adsorption at Crystal-Solution Interfaces. Phoebe P. Davis and W. G. France. *J. Chem. Phys.* 40. *pp.* 81–87, *Jan.*, 1936.—The habit assumed by crystals of lead nitrate and of barium nitrate grown both from pure solutions and from solutions containing foreign materials indicates that of the two possible structures—pyrite and distorted calcium fluoride—suggested by X-ray and crystallographic evidence for these crystals, the latter is most closely approximated. The results obtained on the adsorption of foreign material by growing crystals of lead and barium nitrates furnishes further evidence in favour of the theory previously suggested to account for adsorption and habit modification. The effect on the crystal habit of barium and of lead nitrates of a mixture of two dyes, both of which produce a modification when present alone, is generally, but not always, approximately an additive one. AUTHORS.

***930. Adsorption and Pyknometry. P. G. Nutting.** *Washington Acad. Sci., J.* 26. *pp.* 1–6, *Jan.* 15, 1936.—An investigation of the effect of adsorption on the apparent density of some clays. The samples were initially submitted to a number of conditioning temperatures, and various liquids were used with the samples in the pyknometer. The determined densities are discussed. P. H. B.

See also Abstract 954.

ATOMIC AND MOLECULAR STRUCTURE.

931. Disintegration of Lithium, Boron and Deuterium. K. D. Alexopoulos. *Helv. Phys. Acta,* 8. 7. *pp.* 601–636, 1935. *In German.*—Disintegration experiments are made by bombardment of Li, B, and D with protons and deutons of energy up to 140 kV. The products of disintegration are examined with α- and β-ray counters. With Li, proton bombardment gives rise to α-rays, the range of which is determined by absorption measurements. The α-ray groups of 1·8 cm. and 4 cm. range are estimated to have less than 3 % of the intensity of the 8 cm. group.

The probability of emission of γ-rays is found to be less than 1 quant per 2 disintegrations and the existence of the penetrating γ-ray reported by v. Traubenberg is not confirmed, although the apparatus is 22 times as sensitive. No γ-rays are observed on bombardment of Li with deutons. Boron bombarded by either protons or deutons gives less than 1 quant of γ-rays per 2 disintegrations. With D, bombardment by protons of 140 kV energy gives no appreciable yield of neutrons or γ-rays. With deuton bombardment, however, strong radiation is observed even at low potentials. Coincidence experiments with two counters show that there is about equal probability for the two reactions $_1D^2 + _1D^2 \rightarrow _2He^3 + _0n^1$ and $_1D^2 + _1D^2 \rightarrow _1H^3 + _1H^1$. F. C. C.

932. Disintegration of Nitrogen by Neutrons. T. W. Bonner and W. M. Brubaker. *Phys. Rev.* 49. *pp.* 223–229, *Feb.* 1, 1936.—Nitrogen disintegrations produced by neutrons are observed in a cloud chamber filled with nitrogen at reduced pressures. All of the observed disintegrations are attributed to one of the following reactions:—$_7N^{14} + _0n^1 \rightarrow _5B^{11} + _2He^4$, $_7N^{14} + _0n^1 \rightarrow _7C^{14} + _1H^1$, $_7N^{14} + _0n^1 \rightarrow _2He^4 + _2He^4 + _3Li^7$. The first of these reactions is found to go for "slow neutrons" as well as fast ones. The value of the energy of disintegration for this reaction is 2·33 ± 0·26 eMV. For fast neutrons, the results are similar to those of Kurie, with nearly a constant amount of energy (3·1 eMV) appearing in the disintegration forks. The second and third reactions occur less frequently than the first one. AUTHORS.

933. Yield of Disintegration. G. Stetter. *Phys. Zeits.* 37. *pp.* 88–95, *Feb.* 1, 1936.—The paper deals mainly with the variation among the elements of the yield of disintegration produced by α-particles. The results of investigations by scintillation and ionisation methods, including those recently obtained by the author with a double ionisation chamber, are reviewed. A short review dealing with the yield of disintegration produced by other particles is given. W. E. P.

934. Ranges of α-Particles in Photographic Emulsions. H. J. Taylor and V. D. Dabholkar. *Phys. Soc., Proc.* 48. *pp.* 285–298, *March* 1, 1936.—Numerous α-particle tracks on Ilford R plates are measured. From measurements of the tracks of a homogeneous group of α-particles of range R, a distribution curve may be drawn, from which a length L, known as the extrapolated length of the tracks, can be determined. The ratio L/R is shown to be constant to within 1 % for α-particles of various ranges, and hence R can be found for a group of unknown tracks if L is measured. The method is applied to determine the ranges corresponding to the tracks produced by the disintegration of B and Li under slow-neutron bombardment. These are found to be 1·14 ± 0·02 cm. in air, and 6·64 ± 0·06 cm. in air, respectively. Sm is also investigated, and is found to emit α-particles of range 1·13 ± 0·02 cm. in air. Other particles from Sm, of longer range, are also found. AUTHORS.

935. Resonance Levels for Neutron Capture. H. v. Halban, Jr. and P. Preiswerk. *Comptes Rendus*, 202. *pp.* 133–135, *Jan.* 13, 1936.—After summarising recent work it is suggested that the A neutrons (*i.e.*, those less absorbed by Cd) constitute bands differing for different elements, of energies > *k*T, and velocities slackened by paraffin; that the velocity of any such neutron is reduced by one half by one collision with a proton, and therefore if the width of the band averages that of half its energy, a neutron will belong to this band for only the interval between two collisions, and that therefore activation of the Ag of the indicator

plate can only be caused by neutrons slowed down to the critical velocity of the A band in the layer of paraffin nearest the Ag plate. It is hence probable that in the region of energies > kT there are maxima of resonance for the capture of neutrons by nuclei [see Abstracts 1306 and 2790 (1935)].
C. A. S.

936. Measurement of Neutron Intensities by Rhodium Fermi-Electrons. R. Döpel. *Phys. Zeits.* **37.** *pp.* **96–100,** *Feb.* **1, 1936.**—The author has studied the Fermi-activity of Rh with the object of applying it to the quantitative investigation of neutrons. The half-life periods of the two activities were found to be 35 sec. and 3·81 min. respectively, the initial intensity ratio of the emissions 6·7 and the half-value layer of the electrons in Al 0·45 mm. The optimum conditions for the detection of neutrons by Rh were determined by investigating the variation of the electron yield with the thickness of water surrounding the (Rn-Be) source, the thickness of the Rh foil, and the distance between foil and neutron source. The results of the comparison of various neutron detectors are given and the method of preparing a standard (Ra-Be) neutron source is described.
W. E. P.

937. Energy Distribution of Neutrons Slowed by Elastic Impacts. E. U. Condon and G. Breit. *Phys. Rev.* 49. *pp.* 229–231, *Feb.* 1, 1936.—The problem of finding the distribution in energy of particles of mass m, initially of the same energy, which have made n impacts with particles of mass M all initially at rest, is solved. It is supposed the impacts are elastic and the distribution in angle isotropic in a coordinate system in which the centre of mass is at rest. If x is the ratio of the energy after n impacts to the initial energy then the chance that x lie in dx at x is $(\log 1/x)^{n-1}/(n-1)!$ for $m = M$. For unequal masses the expression is more complicated but easy to calculate. The results have some interest in connection with the slowing of neutrons by elastic impacts with other nuclei, especially with hydrogen nuclei.
AUTHORS.

938. Molecular Dimensions from Viscosity Studies. R. M. Theis and H. B. Bull. *J. Phys. Chem.* 40. *pp.* 125–131, *Jan.*, 1936.—Viscosity measurements of stearic acid and lecithin dissolved in CCl_4 are made at various concentrations, and a linear relation is found when c/η_{sp} is plotted against c. The application of the Eisenschitz equation to experimental results is discussed with reference to ratio of length to diameter of both stearic acid and lecithin.
AUTHORS.

939. Atomic Weight of Rubidium. E. H. Archibald, J. G. Hooley and N. Phillips. *Am. Chem. Soc., J.* **58.** *pp.* **70–72,** *Jan.*, **1936.**—Re-investigation of the atomic weight of Rb through the determination of the silver-rubidium chloride ratio gives a slightly higher value for this constant (85·482) than that accepted by the International Committee.
AUTHORS.

940. Atomic Weight of Element 93. H. J. Walke. *Phil. Mag.* **21.** *pp.* **262–265,** *Feb.*, 1936.—When elements of odd atomic number are single isotopes and two isotopes are missing from the mass spectrum of the preceding even element, it is suggested that the expected heavier isotope of the odd element, as well as the two missing isotopes, is β-radioactive so as to give two successive β-transformations. By assuming that the α-radioactive isotopes correspond to the stable isotopes of non-radioactive elements, and that the β-radioactive isotopes correspond to the missing isotopes the disintegration of elements of odd atomic number greater than 82 can be explained [see Abstract 3234 (1935)]. The theory is illustrated for protactinium and suggests that ${}_{92}U^{239}$ gives rise to ${}_{93}$Eka Re^{239} and ${}_{94}$Eka Os^{239}, and that ${}_{93}$Eka Re^{239} is the heavier and "missing" isotope of element 93. The following scheme is also suggested: ${}_{92}U^{236} + n \rightarrow {}_{92}U^{237} \rightarrow \beta \rightarrow {}_{93}\text{Eka Re}^{237} \rightarrow \alpha \rightarrow {}_{91}Pa^{233} \rightarrow \beta \rightarrow {}_{92}U^{233}$. A discussion is given of ${}_{93}$Eka Re^{238} and the isotopes of U and Eka Os; ${}_{94}$Eka Os^{244} may be of long life and still exist terrestrially. N. M. B.

941. Calculation of Energy of H_3 Molecule. J. Hirschfelder, H. Eyring and N. Rosen. *J. Chem. Phys.* 4. *pp.* 121–130, *Feb.*, 1936.—The potential energies for linear symmetrical configurations of the triatomic hydrogen molecule are calculated by the variational method with hydrogen-like 1*s* atomic orbitals by varying the "effective charge" and the amount of all polar and homopolar states in the eigenfunction. The lowest energies (in k.cal./mol. = 1/23·06 eV) and corresponding separations between neighbouring atoms (in Bohr radii) are given in the table. The activation energies are for the reaction $H + H_2 \rightarrow H_2 + H$, and are calculated with the same type of approximation for H_2 and H_3. All of the difficult three-centre integrals for the repulsions between pairs of electrons were calculated explicitly in ellipsoidal coordinates without the use of infinite series.

	Heitler-London	H.L. plus Polar	Wang	Wang plus Polar	Experiment
$EH_3 - 3EH$	−53·11	−60·39	−56·16	−67·09	−103
rH_3	2·00	2·00	1·89	1·84	
Act. Energy	19·07	13·63	30·68	25·15	7

[See following abstract.] AUTHORS.

942. Calculation of Energy of H_3^+ Ion. J. Hirschfelder, H. Eyring and N. Rosen. *J. Chem. Phys.* 4. *pp.* 130–133, *Feb.*, 1936.—The potential energies for linear symmetrical configurations of H_3^+ are calculated by the same methods [see preceding Abstract]. The energies at the minimum in k.cal./mol. and the corresponding distances between neighbouring atoms in Bohr radii for the various approximations are: Heitler-London − 91·92 at 2·00; H.L. plus polar − 108·64 at 2·00; Wang Approx. − 130·89 at 1·55; Wang plus polar − 155·35 at 1·52. It follows from the use of the variational method that the energy of binding of a proton to H_2 is greater than 46·8 k.cal./mol. If the same Wang plus polar approximation is used for H_2 and H_3^+ a binding energy of 63·11 k.cal./mol. is obtained. The reaction of $H_2^+ + H_2 \rightarrow H_3^+ + H$ may be exothermal and cannot be more than slightly endothermal. AUTHORS.

See also Abstracts 946, 951, 977, 1008, 1029, 1046, 1047, 1053, 1154, 1157, 1177, 1199, 1204, 1206, 1207, 1221, 1261, 1262, 1281, 1305, 1306, 1308, 1324, 1325, 1344, 1345.

COLLOIDS.

943. Lyophilic Colloids. Part III. H. G. B. de Jong and W. A. L. Dekker. *Kolloid Beihefte*, 43. 6–8. *pp.* 213–271, 1935.—This paper deals with the complex coacervation of the system gum-arabic-gelatin [see also Abstract 26 (1936)], and an investigation is made of the material composition of the two layers which are formed when isohydric gelatin- and gum arabic-sols are mixed below pH, 4·8. It is found that: (1) The coacervate contains water, gum arabic and gelatin. (2) In the optimum coacervation within an isohydric series of mixtures, the ratio of the colloid components in the lower layer is equal to that in the whole system. (3) The composition of the optimum coacervate is determined by measurement of the opposite charges. (4) The water content of the optimum coacervate of different pH values exhibits a maximum where the effective attraction is a maximum (*i.e.*, at pH, 3·3 − 3·5). (5) Addition of a desolvatising non-electrolyte (*e.g.*, alcohol) leads to an increase of total colloid content in the complex coacervate, while a neutral salt acts in the opposite manner (6) The water content of the coacervate is dependent on the absolute concentrations of the isohydric sols from whose mixtures it separates. The electrically compensated coacervate is still able to accept an excess of one of the colloid components. In the upper layer true gelatin and true gum arabic are found. Every circumstance which reduces attraction in the coacervate increases also the concentration of the colloid components in the upper layer. The so-called auto-complex coacervation (by which one of the colloid components is replaced by a suitable neutral salt) shows analogy with mixtures of crystalline electrolytes in binary systems salt-water. H. H. Ho.

944. Preparation of Colloidal Solutions by the Silent Electric Discharge. Part IV. S. Miyamoto. *Kolloid Zeits.* 74. *pp.* 32–35, *Jan.*, 1936.—In continuation of previous work [see Abstract 3732 (1935)], the preparation of stable sols of Cu_2O, CuS, Hg, HgS and $Hg(CNS)_2$ by means of the silent electric discharge is described. J. S. G. T.

945. Electrolytic Coagulation of Weak Solvated Sols and Electrolytic Activity. Wo. Ostwald. *Kolloid Zeits.* 73. *pp.* 301–328, *Dec.*, 1935.—A review is given of the theories on neutral salt coagulation of weak solvated sols, heretofore proposed. Particularly the Milner-Debye-Hückel theory is discussed with respect to variations in activity coefficient with structure and valency of electrolytes, tables and curves being made use of for this purpose. It is shown from a number of tables on coagulation values by calculating f_+, f_-, and $f_\pm$ that neutral salts coagulate weak, solvated sols at equal activity coefficients of the dominant ions in the dispersion medium. The activity theory is also applied to other problems than those of structure and stability of sols. J. K.

946. Molecular Weight of Polystyrenes and the Shape of the Molecules in Solutions. R. Signer. *Faraday Soc., Trans.* 32. *pp.* 296–307, *Jan.*, 1936.—Determinations of the molecular weights of polystyrenes by means of the ultracentrifuge lead to the conclusion that either the molecules are not straight rods (as is assumed) or that hydrodynamical laws no longer apply in the case of very thin threads. Velocities of sedimentation, extrapolated to infinite dilution, are in accordance with the assumption that the polystyrene threads form spheres whose volume is about 10 times that of a thread, but this is not confirmed in strong solutions. Ordinary hydrodynamical methods do not seem applicable to the problem. All polystyrene solutions show negative flow-birefringence, the magnitude being comparable with that for ethyl oleate. For molecular weights up to 50,000, the results are in accordance with the orientation theory, but this breaks down for higher molecular weights. It is shown that all these phenomena can be explained on the basis of a *flexible* long-thread form for the polystyrene molecule, and this is supported by the abnormal viscosities of polystyrene solutions. C. B. A.

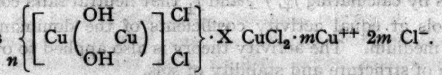
947. Maxwell Effect in Colloids. A. M. Taylor. *Faraday Soc., Trans.* 32. *pp.* 307–310; *Disc.*, 310–315, *Jan.*, 1936.—Two experiments are suggested for deciding between the "orientation" and "strain" (W. Kuhn) theories of flow-birefringence in colloids. The first consists in simultaneous observation of the Maxwell and Kerr effects; the second in examining the dichroism of the dye-stained sol whilst streaming.

C. B. A.

948. Absorption and Scattering of Light in White Sols. B. Težak. *Kolloid Zeits.* 74. *pp.* 16–22, *Jan.*, 1936.—The relation between absorption and Tyndall light-scattering is investigated for sols of colophonium and acetyl-cellulose for radiation of wave-lengths 470, 530 and 625 $m\mu$. The Lambert-Beer law is found to be obeyed. J. S. G. T.

949. Swelling Power of Potato Starch. E. Wiegel. *Kolloid Zeits.* 74. *pp.* 58–66, *Jan.*, 1936.—It is shown that the process of thickening of starch in warm water, viscometrically determined, and particularly the position of the maximum-viscosity, depend in large measure on the type and quantity of bases contained by any particular starch. Starches are treated with acids, of different concentrations and for various periods of time and at various temperatures; after being so treated they are well washed; starches are also neutralised with alkalies and alkaline earths respectively. These are then investigated as to their swelling in water at various temperatures up to 95° C. J. K.

950. Structure of Colloidal Particles of Artificial Atacamite. A. A. Morosow. *Kolloid Zeits.* 73. *pp.* 288–299, *Dec.*, 1935.—There are tables and curves on the rate of reaction of 0·2 *N* solutions of copper acetate with solutions of NaCl of different concentrations, on the determination of the specific conductivity of the sol and its ultrafiltrate by dilution with twice distilled water, on the determination of the charge value of the colloidal particles of atacamite, on the calculation of electro-equivalents according to Wintgen and on the coagulation of atacamite by NaCl and by $Na_2\,SO_4$. The structure proposed for the colloidal particles of atacamite is



$${}_{n}\left\{\left[\mathrm{Cu}\left(\begin{matrix}\mathrm{OH}\\ \mathrm{Cu}\\ \mathrm{OH}\end{matrix}\right)\right]\begin{matrix}\mathrm{Cl}\\ \\ \mathrm{Cl}\end{matrix}\right\}\cdot X\ \mathrm{CuCl_2}\cdot m\mathrm{Cu}^{++}\ 2m\ \mathrm{Cl}^{-}.$$

J. K.

951. X-Ray Spectrography of Polymers. J. R. Katz. *Faraday Soc., Trans.* 32. *pp.* 77–94; *Disc.*, 94–96, *Jan.*, 1936.—The results of X-ray analysis of crystalline polymerisates as well as of amorphous patterns of synthetic polymers are discussed. It is pointed out that in 1926 the author undertook the study of the amorphous patterns of rubber and polymers and compared them with the X-ray patterns of about 400 organic liquids. X-ray phenomena observed in the stretching of natural rubber are described as well as what has been found for synthetic substances which "crystallise" when stretched. Polyvinyl alcohol, polyethylene tetrasulphide (thiokol), polychloroprene, polybromoprene, methyl and isoprene rubbers are discussed in this connection and it is pointed out that the synthesis of rubber ought to be done under X-ray check. J. K.

952. Constitution of Hydrous Oxide Sols from X-Ray Diffraction Studies. H. B. Weiser and W. O. Milligan. *J. Phys. Chem.* 40. *pp.* 1–7, *Jan.*, 1936.—X-ray diffraction examination of the moist gels from typical hydrous oxide sols indicates that the particles of the solid phase in such sols consist essentially of aggregates of minute crystals of hydrous oxides or of simple oxide hydrates. In the sols containing chloride, the latter is not bound in the form of a basic salt in most cases, but is adsorbed in an amount depending on the size and physical character of the particles.

AUTHORS.

953. Mechanism and Kinetics of Thixotropic Solidification. W. Heller. *Comptes Rendus,* 202. *pp.* 61–64, *Jan.* 6, 1936.—The thixotropic gels formed when 0·03–0·06 *M* NaCl is added to a 110 μ mol. solution of Fe_2O_3 (2 hrs.) are centrifuged for from 10–190 min., and the percentages of solid gel determined. The results are explicable if thixotropic solidification is regarded as depending on (1) the rate of formation of germs (" centres of jellification "), (2) the rate of growth of these germs into elementary gels (" geloids "), and (3) the rate at which these geloids associate together. Accordingly the question whether the solid resulting from thixotropy consists of a net of gel enclosing liquid, or of a uniform, and homogeneous gel reduces to one of time. [See Abstract 2949 (1930).]
C. A. S.

954. X-Ray Spectrography of Alkali Celluloses. J. B. Calkin. *J. Phys. Chem.* 40. *pp.* 27–35, *Jan.*, 1936.—X-ray data are correlated with previous adsorption values for cotton. It is shown that cotton treated with NaOH in ethyl alcohol solution does not form mercerised cotton. Pretreated cotton forms Na-Cell I at a lower concentration than native cotton. It is not possible to obtain Na-Cell III′ under the present experimental conditions. A sodium cellulosate is formed which is adsorbed by the cellulose. The use of the X-ray method to supplement adsorption curves is very important and can be used very profitably. AUTHOR.

955. Electrical Orientation of Wool Cells. H. J. Woods. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 132–134, *Jan.*, 1936.—A method of obtaining films of oriented wool cells by sedimentation from an aqueous suspension in an alternating electric field is described. Using these films an X-ray fibre photograph is obtained which is identical with that of normal α-keratin in the untreated fibres. AUTHOR.

***956. Applications of a Simple Air-Driven Centrifugal Machine to Colloid-Chemistry Problems. J. W. McBain and R. F. Stuewer.** *Kolloid Zeits.* 74. *pp.* 10–16, *Jan.*, 1936.—Uses of the air-driven centrifugal machine invented by Henriot and Huguenard (see Abstract 2013 (1925)] in colloid-chemistry are briefly discussed. Amongst the phenomena are investigations of sedimentation, the Donnan effect, swelling, the structure of gels, combined water. The structure of gels is discussed and experimental results relating to the swelling-pressure and velocity of sedimentation of agar sols are given. J. S. G. T.

See also Abstracts 990, 1000, 1044, 1265, 1321.

CRYSTAL STRUCTURE AND PROPERTIES.

957. Arrangement and Diffusion Processes in Copper-Gold Solid Solutions. W. S. Gorsky. *Phys. Zeits. d. Sowjetunion,* 8. 4. *pp.* 443–456, 1935. *In German.*—The author has shown [see Abstract 4409 (1934)] that, for a CuAu alloy containing 50 atomic % Au, the ratio of tetragonal to dygonal parameter of the lattice depends on the temperature. An attempt is made to account theoretically for the mechanism involved and to deduce the diffusion coefficient. Three atomic models are suggested, but an examination of each shows that none of them is capable of giving a satisfactory explanation of the experimental data. [See following Abstract.] H. J. H. S.

958. Elastic Secondary Effect in Random Solid Solutions. W. S. Gorsky. *Phys. Zeits. d. Sowjetunion,* 8. 4. *pp.* 457–471, 1935. *In German.*—It is shown that existing theories which account for the elastic secondary effect after plastic deformation are not completely satisfactory. A theory is put forward which relates the secondary effect in solid solutions with diffusion; a calculation of the velocity of the process shows that, for distorted single crystals, the secondary effect proceeds almost infinitely slowly if the thickness is greater than 10^{-3}—10^{-4} mm. An attempt is made to explain the secondary effect in polycrystalline metals and alloys by diffusion. [See preceding and following Abstracts.]

H. J. H. S.

959. Elastic After-Effect in Regular Copper-Gold Alloy. W. S. Gorsky. *Phys. Zeits. d. Sowjetunion,* 8. 5. *pp.* 562–571, 1935. *In German.*—For proof of the theory previously described [see preceding Abstract] the elastic after-effect in the regular tetragonal lattice of Cu-Au is investigated. In multiple crystals an after-effect of 60 % to 100 % of the elastic deformation and in single crystals one of 10–15 % to 60 % according to the orientation is established. The measured magnitudes represent the order of magnitude of the effect mentioned. The velocity of the process increases with rising temperature.

J. J. S.

960. Al-Mg Alloys. P. Vachet. *Rev. de Mét.* 32. *pp.* 614–626, *Dec.,* 1935.—Alloys of Al and Mg containing under 14 % Mg (*i.e.,* alloys in industrial use) are examined by several methods. X-rays are used to determine the effect of Mg on the lattice size of Al and dilatometer studies are also made. The mechanical characteristics of the alloys are considered and their resistance to corrosion is examined. In both these respects the alloys are satisfactory.

J. T.

961. Metallic Crystals. E. Schmid. *Rev. de Mét.* 32. *pp.* 638–648, *Dec.,* 1935.—A survey is given of the work which has been done on the systematic examination of single crystals of metals. The determination of structure by X-rays is described and the mechanism of transformation studied. The physical properties of single crystals are discussed, and the properties of aggregates considered in relation to them. Finally, the subjects of plastic deformation and the occurrence of supersaturated phases are studied.

J. T.

962. Copper-Gold System. C. H. Johansson and J. O. Linde. *Ann. d. Physik,* 25. 1. *pp.* 1–48, *Jan.,* 1936.—A new phase (CuAu II) is discovered in the Cu-Au system. It occurs within a range extending from 40 % to 64 % (atomic) of Au. Its structure is investigated by X-ray methods and is found to be orthorhombic. The structure is considered as a CuAu (I) structure (which is tetragonal) with periodic phase-differences. The influence of such phase-differences on the lattice deformation and electrical resistance, is investigated. In the region 65 % to 80 % (atomic) of Au, the tempered alloys show a cubic structure with weak lines due to a super-lattice.

J. T.

963. Explosive Antimony. Part III. Magnetic Susceptibility. C. C. Coffin. *Canad. J. of Research,* 13. *Sect. A. pp.* 120–125, *Dec.,* 1935.—Explosive Sb is not as diamagnetic as the ordinary polycrystalline metal. The magnetic susceptibilities are respectively $-0 \cdot 38 \times 10^{-6}$ and $-0 \cdot 88 \times 10^{-6}$. The explosive or amorphous form should therefore be regarded as a true glass of the supercooled liquid. The fact that it is less "metallic" than the molten metal cannot be the result of the metallic binding of the liquid or crystalline state changing to homopolar binding in the amorphous state. [For Part II see Abstract 4449 (1935)].

AUTHOR.

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964. Arrangement of Micro-Crystals of Silica in the Onyx. M. Ichinose. *Kyoto Coll. Sci., Mem.* 18. *pp.* 315–317, *Nov.*, 1936.—By means of an X-ray diffraction-photograph, it is ascertained that micro-crystals of quartz in the onyx take a fibrous arrangement, whose common axis is $[11\bar{2}0]$, perpendicular to the surfaces of the banded layers in the mineral. AUTHOR.

965. Polymorphism. H. E. Phipps and J. H. Reedy. *J. Phys. Chem.* 40. *pp.* 89–100, *Jan.*, 1936.—A new method for determining the transition temperature of soluble substances by means of the dipping refractometer is devised. This method is especially useful in cases where the velocity of transition is so small that ordinary methods are inaccurate. It is much simpler and faster than the solubility method and just as exact. Examination of ammonium nitrate III by means of a petrographic microscope indicates that it is orthorhombic. The transition point of CCl_4 is redetermined as $-47 \cdot 66 \pm 0 \cdot 2$°C. from heating and cooling curve measurements. This temperature is affected by impurities nearly three times as much as the melting point, and is not recommended as a fixed point in thermometry. AUTHORS.

966. Polymorphic Transformations of Simple Ionic Lattices. Part I. Transformation of CsCl into NaCl Lattices by Heat. G. Wagner and L. Lippert. *Zeits. f. phys. Chem.* 31. *Abt.B.* 4. *pp.* 263–274, 1936.—The lattice constants, *a*, of CsCl, CsBr and CsI are determined up to 530°, 580° and 560° respectively. In CsCl the lattice changes to that of NaCl at 445 ± 5°, accompanied by decrease in *d* from 3·64 to 3·21, change of *a* from 4·24 to 7·02 and emission of 1·8 k.cal. per mol. In the cases of CsBr and CsI there is merely increase in *a* and decrease in *d*; TlCl and TlBr behave similarly, but TlI shows some indication of change of structure at 390°, but apparently not to another cubic form. C. A. S.

967. Crystallochemical Relations between Germanium and Silicon. W. Schütz. *Zeits. f. phys. Chem.* 31. *Abt. B.* 4. *pp.* 292–308, 1936.—The isomorphism between Si and Ge is shown by the following data:

	a (hex)	*c* (hex)	β (rhomb)	*d*
Zn_2SiO_4	13·92	9·33	107 45′	4·226
Zn_2GeO_4	14·19	9·46	107 50′	4·823
Be_2SiO_4	12·42	8·23	107 59′	2·985
Be_2GeO_4	12·77	8·41	108 6′	3·868
Cs_2SiF_6	8·89	—	—	3·841
Cs_2GeF_6	8·99	—	—	4·107

A series of BeO-GeO_2 glasses is prepared by heating the components for 1 day at 750°, 3 at 950°, cooling quickly to 450° and then slowly to 20°; n_{6438} for glasses containing 18·8, 25 and 31 % GeO_2 is 2·0847, 1·981 and 1·926; $n_{4358} - n_{6438}$ 0·1127, 0·089 and 0·067 respectively. Corresponding figures for glasses containing 48·66 % GeO_2, 45·78 PbO, 6·50 K_2O, 0·36 BaO and 0·46 As_2O_3 heated finally to 1000° and 1150° are 1·798 and 1·739, and 0·068 and 0·043 respectively. C. A. S.

968. Anhydrous Sulphates of Magnesian Series. F. Hammel. *Comptes Rendus,* 202. *pp.* 57–59, *Jan.* 6, 1936.—X-ray examination of the anhydrous sulphates of this series shows them all to be crystalline—orthorhombic, the values of *a*, *b*, and *c* being for that of Mg $4\cdot8_2$, $6\cdot7_2$, $8\cdot3_3$; of Mn $4\cdot8_6$, $6\cdot8_4$, $8\cdot5_8$; of Fe $4\cdot8_2$, $6\cdot8_4$, $8\cdot6_7$; Co $4\cdot6_5$, $6\cdot6_6$, $8\cdot4_6$; Ni $4\cdot6_2$, $6\cdot5_1$, $8\cdot4_9$; Cu $4\cdot8_8$, $6\cdot6_6$, $8\cdot3_2$; and of Zn $4\cdot7_1$, $6\cdot7_3$, $8\cdot5_1$. [See Abstract 4009 (1934).] C. A. S.

969. Graphite from Diamond. P. Corriez. *Comptes Rendus,* 202. *pp.* 59–61, *Jan.* 6, 1936.—Graphite prepared by heating diamond at 1900°, when examined by X-rays, showed much better developed crystallites than those in sugar carbon heated at 2000°. Its resistivity, though less than that of the sugar carbon, is still substantially greater than that of Madagascar graphite, relative values averaging 0·169, 0·198 and 0·126 respectively. Its magnetic susceptibility approximates to that of the sugar carbon. [See Abstract 411 (1936).] C. A. S.

970. Structure of Thin Films of Metallic Oxides and Hydrates. N. Smith. *Am. Chem. Soc., J.* 58. *pp.* 173–179, *Jan.,* 1936.—This paper describes an investigation of the structures of thin films of metallic oxides, hydroxides and hydrates, prepared in various manners, by the method of electron diffraction. Oxide films removed from heated metals were found to be polycrystalline, consisting of relatively large crystals of the normal metallic oxides: nickelous oxide, in the case of nickel, cuprous oxide, in the case of copper, and predominantly ferrosic oxide in the case of iron. Estimates of crystal sizes in the films indicate that they consist of only a few layers—possibly even but a single layer—of crystals. The films showed no indications of preferred orientation or of pseudomorphism. In one case evidence of lattice distortion during the oxidation process was found. Films of hydroxides and hydrates precipitated from solutions of metallic salts were found to be always crystalline, but usually with quite small crystals, approaching amorphousness. The crystals also showed evidence of lattice distortion, arising probably from the manner of their formation. H. H. Ho.

971. Structure of Acetylsalicylic Acid. S. Kôzu and K. Takané. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 381–382, *Nov.,* 1935. *In English.* The unit cell has *a* 11·36, *b* 13·22, *c* 22·30, *β* 94° (approximately), compared with $a : b : c = 1\cdot7120 : 1 : 1\cdot6809$, *β* 95° 27′ by goniometer. This gives 15 molecules per unit cell, a figure considered less probable than 16, which, however, would imply an error of about 7 % in the size of the unit cell. Space group C_{2h}^{2} or C_2^2. C. A. S.

972. Orientation of Molecules of Beeswax and its Effect on Solidity of Comb. P. Woog and N. Yannaquis. *Comptes Rendus,* 202. *pp.* 76–78, *Jan.* 6, 1936.—When one portion of a honeycomb is kept at 15° and the other at 38° for five months the latter is much stronger; similarly when two portions of beeswax are shaped into ribbons and treated in the same way the heated portion is 58% stronger than the other. The heated wax is more translucent, but darker coloured. The bearing of these facts on the construction of the comb is discussed. [See Abstract 412 (1936).] C. A. S.

973. Electron Distribution in $(NH_4)_2C_2O_4\cdot H_2O$ and Structure of Oxalate Group. S. B. Hendricks and M. E. Jefferson. *J. Chem. Phys.* 4. *pp.* 102–107, *Feb.,* 1936.—The electron distribution of $(NH_4)_2C_2O_4\cdot H_2O$ projected on (001) is obtained by a Fourier analysis making use of quantitative intensity measurements of X-ray scattering from (*hk*0). This analysis combined with a determination of the atomic parameters perpendicular to (001) give the complete structure. Separations of covalently linked atoms in the $C_2O_4^{--}$ group are C – C, 1·581 ± 0·01 Å; C – O, 1·25 ± 0·02 Å; and C – O, 1·23 ± 0·02 Å with the angle O – C – O = 129° ± 2°. In this compound the O – C – O parts of an oxalate group are in planes at an angle of 28° while in $H_2C_2O_4 \cdot 2H_2O$, *α* and *β* $H_2C_2O_4$ the parts are coplanar. AUTHORS.

974. Structure of Nitrogen-Substituted Sulphon-*p*-toluidides. G. H. Young, W. J. Keith and A. P. Honess. *Zeits. f. Krist.* 93. *pp.* 107–112, *Jan.*, 1936. *In English.*—The following *p*-toluene-sulphon-N-alkyl-*p*-toluidides have been measured crystallographically :

Alkyl	Crystal System	*a* : *b* : *c*	*β*
methyl	monoclinic-prismatic	0·5479 : 1 : 0·6856	84°16′
ethyl	orthorhombic-bipyramidal	1·4582 : 1 : 0·7505	—
isopropyl	monoclinic prismatic	1·3832 : 1 : 0·9413	85°34′30″
isobutyl	do. do.	1·6192 : 1 : 1·4722	75°15′40″
n-amyl	do. do.	1·6674 : 1 : 0·6139	75°18′
isoamyl	do. do.	0·6000 : 1 : 0·9275	61°56′30″

Gnomonic and orthographic projections of all are given. [See also Abstract 409 (1936).] C. A. S.

975. Structure of Dibenzyl Derivatives. M. Milone. *Zeits. f. Krist.* 93. *pp.* 113–115, *Jan.*, 1936. *In English.*—The constants determined are :—

	α-Diphenyl-glyoxime.	Diphenyl-glyoxime peroxide.	Diphenyl-furazane.
a, *b*, *c*	25·08, 8·68, 11·92 Å	12·85, 6·27, 14·96 Å	11·89, 12·95, 6·99 Å
Density (found)	1·336	1·353	1·312
Density (calc.)	1·416	1·430	1·361
No. of molecules per unit cell	8	4	4
Space group	C_{2h}^6(C2/*c*)	C_{2h}^5($P2_1/c$)	D_2^4($P2_12_12_1$)

F. I. G. R.

976. X-Ray Diffraction Patterns of Organic Liquids. S. Tanaka and Z. Muro. *Phys. Math. Soc., Japan, Proc.* 17. *pp.* 548–555, *Dec.*, 1935. *In English.*—X-ray diffraction patterns of a large number of pure organic liquids and mixtures of two and three liquids are studied by the method previously described [see Abstract 2705 (1931)]. The conclusions of the previous work are amply confirmed : that a mixture of two liquids gives a characteristic pattern, and not the haloes due to the constituent liquids indicating that the halo is due to the arrangement of the molecules in the liquid and not to the inner molecular structure ; also that the haloes appear where the most intense lines occur in the crystal powder pattern,

showing that the crystal planes producing the strongest reflections in the solid state maintain their properties when the crystal becomes liquid.
C. J. B. C.

977. Orientation of Liquid Molecules from X-Ray Diffraction Effects. A. Peterlin. *Phys. Zeits.* 37. *pp.* 43–52, *Jan.* 15, 1936.—The complete X-ray diffraction pattern is derived for liquid CCl_4 based upon the consideration of molecular orientation. Agreement is found with Pierce's but not with Menke's measurements. For liquids with approximately spherical molecules a complete interpretation of the X-ray diffraction is possible. The mutual energy of the schematic molecule as a multipole of the third order was taken as basis for the orientation. The paper is mathematical throughout. In the least liquid region, the average distance between the molecules of CCl_4 is of greater order than it would be in a gas of the same density, and in this region the structure of the liquid is similar to that of a strongly extended crystal lattice. The X-ray diffraction effects enable an estimation of dimensions in this region. H. H. Ho.

978. Structure of Liquid Solutions from X-Ray Data. V. Danilow. *Acta Physicochimica,* 3. 5. *pp.* 725–740, 1935. *In German.*—Two examples, water and mercury, lead to the view that at low temperatures, the liquid state approximates in arrangement more closely to the solid than to the gaseous. A number of curves (intensity-angle) are discussed for water and several binary compounds. F. I. G. R.

979. Structure of Anisotropic Liquids. V. Freedericksz. *Acta Physicochimica,* 3. 5. *pp.* 741–748, 1935. *In German.*—A discussion dealing with the following factors—light scattering, change of dielectric constant, orientation, boundary effects—in liquid crystals. F. I. G. R.

980. Liquid Crystals of Cholesterine Compounds and their Crystalline Surfusion. P. Gaubert. *Comptes Rendus,* 202. *pp.* 141–143, *Jan.* 13, 1936.—By fusion with cholesterine a number of new liquid crystal bodies are formed, *e.g.*, by melting with pyrogallol, saccharine, etc. Their characters resemble those compounds of cholesterine which are crystallographically positive. There are slight variations of viscosity.
F. I. G. R.

981. Molecular Swarm Formation in Liquids. R. Gans. *Phys. Zeits.* 37. pp. 19–22, *Jan.* 1, 1936.—Light scattered by a liquid at right angles to the primary ray direction is found to consist of a mixture of plane polarised and natural light when the primary ray is plane polarised. Density fluctuations alone would yield only plane polarised scattered light under these conditions. The depolarisation is explained as due to chance anisotropies as well as density fluctuations of the volume elements. A theory on these lines is developed which relates the degree of depolarisation with the volume and shape of molecular swarms forming the volume elements. Observations by Krishnan of mixed plane polarised and natural light scattered by a mixture of two fluids above the critical temperature of complete miscibility are interpreted in the theory, which indicates that in this case the molecular swarms must have been thread shaped.
W. S. S.

982. Rhythmic Crystallisation. M. M. MacMasters, Julia E. Abbott and C. A. Peters. *Am. Chem. Soc., J.* 57. *pp.* 2504–2508, *Dec.,* 1935.—A distinction is drawn between fine and coarse rhythm in the crystallisation from aqueous solutions of $K_2Cr_2O_7$. The former is a true test of periodicity. The inhibition of fine rhythm (for the same salt) is most marked by ions in the following order of decreasing effectiveness: nitrate, sulphate, chloride. F. I. G. R.

983. Kinetics of Recrystallisation of Tin, Cadmium and Iron. M. Kornfeld and F. Sawizki. *Phys. Zeits. d. Sowjetunion*, 8. 5. *pp.* 528–532, 1935. *In German.*—It is shown that as in the case of Al previously investigated an incubation period precedes the appearance and growth of new grains in the crystallisation of Sn, Cd and Fe, and that the growth proceeds with constant velocity. Full experimental details are included in the paper. H. H. Ho.

984. Grain Formation and Recrystallisation. Part II. M. Kornfeld. *Phys. Zeits. d. Sowjetunion*, 8. 5. *pp.* 533–535, 1935. *In German.*—In continuation of previous work [see Abstract 3275 (1935)], it is shown that crystallisation nuclei are produced in consequence of an irreversible process commencing at a definite region of the deformed material at the commencement of annealing. This result is deduced thermodynamically. J. S. G. T.

985. Nucleus Formation on Crystals of Nickel Sulphate Heptahydrate. W. E. Garner and W. R. Southon. *Chem. Soc., J. pp.* 1705–1709, *Dec.*, 1935.—It is pointed out that since it is not possible to measure the rate of growth of nuclei before they have reached 10^{-4}–10^{-3} cm. in size, it is uncertain at what stage in the building up of the nuclei the abnormally slow rate of growth occurs. This has been suggested as the cause of the induction periods in solid reactions. It has been found that the nuclei formed on the dehydration of $NiSO_4,7H_2O$ consist of half-ellipses with one direction of growth on the crystal surface and the other into the interior at an angle of 45° to the surface, that before nuclei appear there is an induction period decreasing in length with rise in temperature, and that the rate of growth of the nuclei is linear above 10^{-3} cm., but is abnormally slow during the induction period. It has also been found that the temperature coefficient of the induction period is the same as that of the rate of growth, and that the numbers of nuclei increase with time, according to $N_t=k(t-t_1)^2$. J. K.

986. Stabilisation of Small Crystals by Hydration of their Crystal Surfaces. E. Herlinger. *Zeits. f. Krist.* 93. *pp.* 37–41, *Jan.*, 1936. —From the appropriate energy-comparisons it appears that, (1) relatively large grain size in heteropolar lattices can be expected in aqueous solution, (2) very small heteropolar crystals are not likely to be dissolved in water, (3) ultramicroscopic crystals "last" a very long time, (4) diminution is abruptly checked. F. I. G. R.

987. Optical Anisotropic Constants of Absorbing Crystals. M. Berek. *Zeits. f. Krist.* 93. *pp.* 116–135, *Jan.*, 1936.—The anisotropy of absorbing minerals between crossed Nicols in incident light serves for determining parameters a knowledge of which leads to evaluation of the optical symmetry, the (complex) optical character, the magnitude of the (complex) double refraction, and the ratio of the uni-radial reflectivities. F. I. G. R.

988. Phenomenon Associated with Transformations Occurring over a Temperature Range. A. Schulze. *Phys. Zeits.* 37. *pp.* 41–43, *Jan.* 15, 1936. *From the Reichsanstalt.*—The physical properties of Ni at temperatures below the characteristic transformation temperature show certain anomalies. These are described and discussed for the case of

Ni carbonyl with reference to the thermal expansion-temperature and electrical resistance-temperature curves. [See also Abstract 3560 (1935).]
H. J. H. S.

989. Plastic Deformation of Cadmium Single-Crystals. R. Roscoe. *Phil. Mag.* 21. *pp.* 399–406, *Feb.*, 1936. *Supplement.*—It is concluded from observations on the bending of single-crystal wires, that, when the stress over the glide-planes of a crystal is not uniform, slip begins when the *maximum* value of the resolved shear stress reaches the critical value for deformation under uniform stresses. Measurements show that surface oxidation of cadmium single-crystals produces an increase in their resistance to plastic deformation which cannot be due to the cohesion of the oxide film. It is suggested that the added strength has its origin in the healing of submicroscopic cracks by the film. AUTHOR.

***990. Fibre Diagrams. E. Sauter.** *Zeits. f. Krist.* 93. *pp.* 93–106, *Jan.*, 1936.—The interpretation of fibre-diagrams of organic compounds of high molecular weight, such as cellulose, rubber, albumin, etc., has been rendered difficult by the restricted data obtained with plain or cylindrical films. To overcome this, the author suggests the use of a conical film, the axis of which is parallel to the fibre axis. A camera designed to take such a film is described and examples are given of its use, well-known fibre-diagrams being illustrated. The advantages of the method are outlined and the method of working out the " cone " fibre-diagrams is given. This is no more complicated than the method for ordinary fibre-diagrams.
J. T.

991. Precision Photographs by Debye and Scherrer's Process. Part II. M. Straumanis and A. Ievins. *Zeits. f. Physik,* 98. 7–8. *pp.* 461–475, 1936.—Previously a description was given of a new process for the determination of the glancing angle [see Abstract 2373 (1935)], and further details are now given. By a new arrangement of the film in the camera, not only can the advantages of the usual method of introduction be combined with those of van Arkel but further advantages are obtained, such as independence of reference substances, film crumpling and camera diameter. The method is an absolute one and depends only on the wave-length employed. With a precision film all that is necessary for the determination of the glancing angle is obtained with the least possible work of calculation since the interference lines themselves are used as reference marks. Various lattice constants are given. J. J. S.

***992. Apparatus for X-Ray Patterns of the High Pressure Modifications of Ice. R. L. McFarlan.** *Rev. Sci. Instruments,* 7. *pp.* 82–85, *Feb.*, 1936.—The stability of the high pressure ice forms discovered by Tammann and Bridgman at very low temperatures and atmospheric pressure has made it possible to obtain X-ray diffraction photographs of these forms. A discussion is given of a low temperature powder camera designed (1) to permit continuous rotation of the crystal, (2) to permit very rapid insertion and centring of the crystal, (3) to permit evacuation of the diffraction chamber. A detailed description of the experimental technique is made including the operation of the camera, and a method for powdering the ices by grinding and repacking them while under liquid air. Two diffraction patterns of the high pressure ices are shown. AUTHOR.

993. Lattice Constants, 1936. M. C. Neuburger. *Zeits. f. Krist.* 93. *pp.* 1–36, *Jan.*, 1936.—The usual data [see Abstracts 326

(1932) and 444 (1934)] are given, revised and brought up to date (138 references). C. A. S.

See also Abstracts 929, 955, 994, 997, 998, 1061, 1184, 1186, 1187, 1231, 1239, 1255, 1256, 1308, 1315, 1357, 1360, 1363, 1365.

DENSITY.

994. Density of Liquid Phosphorus. S. Dobiński. *Acad. Polonaise Sci. et Lettres, Bull.* 5–6 *A. pp.* 253–261, *May-June*, 1935. *In English.*—Analytical quality phosphorus is dried and distilled *in vacuo* into a calibrated pear-shaped dilatometer of bulb volume 32 cm.^{3} having a 3 mm. tube sealed to its neck. The position of the phosphorus surface in the tube is observed at 15 temperatures between and including 7·0° C. and 68·3° C. The weight of phosphorus in the dilatometer is determined in terms of the difference between the weight of the full dilatometer and the broken dilatometer from which the phosphorus had been extracted under water. The equation $d = 1{\cdot}78685 - 0{\cdot}0009386t$ agrees with the experimental data within $1{\cdot}3 \times 10^{-4}$ and is in accordance with the results of most other workers. On supercooling the liquid becomes turbid but clears slowly, when about 0·01 cm.^{3} of an orange coloured liquid gathers at the surface. The existence of a maximum velocity of crystallisation at 24·9° C. reported by Tammann is not confirmed. P. H. B.

995. Specific Volume and Density of Solutions. P. N. Pawlow. *Acta Physicochimica*, 3. 5. *pp.* 756–765, 1935. *In German.*—On the basis that, liquid and crystalline materials, under the same conditions of temperature and pressure, contain per unit volume the same number of associated molecules, expressions are derived for the law of partial densities of the components of a solution, the law of density of a solution, and expressions for the contraction or expansion accompanying solution. J. S. G. T.

996. Density of Solutions of Alkali Metal Halides in Liquid Ammonia. W. C. Johnson and R. I. Martens. *Am. Chem. Soc., J.* 58. *pp.* 15–18, *Jan.*, 1936.—The density of solutions of the chlorides, bromides and iodides of Li, Na and K are determined over a range of concentration and of temperature. A method for carrying out these measurements is described. AUTHORS.

See also Abstracts 930, 1029, 1069.

DIFFUSION AND OSMOSIS.

997. Diffusion Velocity in Metals and Crystallographic Orientation (Anisotropic Diffusion). W. Bugakow and N. Breschnewa. *Techn. Phys., U.S.S.R.* 2. 5. *pp.* 435–443, 1935. *In German.*—An investigation is made of the velocities of diffusion of Hg into Cd and into Zn single crystals in different crystallographic directions. In both cases the diffusion velocity is greatest in the direction parallel to the base plane and least perpendicular to this plane. Increase of temperature decreases the importance of the crystallographic direction for the velocity of the process, *i.e.*, it decreases the degree of anisotropy of the diffusion. The diffusion velocity of Cu into Zn unit crystals is also investigated and analogous results obtained. H. H. Ho.

998. Diffusion Coefficients of Metals and Grain Magnitudes. W. Bugakow and F. Rybalko. *Techn. Phys., U.S.S.R.* 2. 6. *pp.* 617–623, 1935. *In German.*—This investigation deals with the alteration in the diffusion coefficients of brass on transition from single- to polycrystals, and for different grain magnitudes in the polycrystal. The absolute value of the diffusion coefficient increases appreciably during the transformation from single- to polycrystals. The heat of relaxation, which has been evaluated from the temperature curve of the diffusion coefficient, decreases on transition from the single- to the polycrystal, but remains constant during further diminution of the grain. An explanation of the results is based on the general theoretical presentation of diffusion phenomena. The results are compared with data obtained by by electrolytic conductivity measurements. H. H. Ho.

999. Diffusion of Silver in Glass. O. Kubaschewski. *Zeits. f. Elektrochem.* 42. *pp.* 5–7, *Jan.*, 1936.—Metallic Ag and soda glass only react in the presence of O_2 and the amount of Ag penetrating into the glass is dependent of the O_2 pressure in the immediate vicinity. The diffusion coefficient is measured and the results, when compared with those of Güntherschulze for the diffusion of Ag from $AgNO_3$ into glass, seem to indicate that the Ag immigration is by ions. H. J. H. S.

1000. Diffusion Coefficient and Apparent Radius of the Cupric Ion in Silica Gels. W. G. Eversole and E. W. Doughty. *J. Phys. Chem.* 40. *pp.* 55–60, *Jan.*, 1936.—A photometric method is used to study the diffusion of cupric chloride into gels. The most probable value of the diffusion coefficient of the cupric ion in water is $4 \cdot 6 \times 10^{-6}$ cm.^{2} per sec. A value of approximately $5 \cdot 2 \times 10^{-8}$ cm. is suggested for the effective radius of the hydrated cupric ion in solution. AUTHORS.

***1001. Permeability of Compacted Powders. Determination of Average Pore Size. R. N. Traxler and L. A. H. Baum.** *Physics*, 7. *pp.* 9–14, *Jan.*, 1936.—With air as the diffusing medium a method and apparatus are developed for measuring the permeability of compacted, unconsolidated powders. A formula is given for calculating the average pore diameter from the permeability and the percent of voids in the compacted powder. By establishing a simple relationship between the degree of packing, as measured by the percent voids, and the average individual pore diameter it is possible to calculate the pore size in a comminuted solid for any degree of compaction. When liquids (*e.g.*, bitumen, sulphur, etc.) are stabilised by the addition of solid particles, the degree of packing of the particles and the dimensions of the films and masses of liquid separating them exert a profound influence on the consistency of the mixture. Thus, a knowledge of the average pore diameter of a powder as present in a solid-liquid system is of practical value. The influence of average particle size on average pore diameter is studied and data are presented for silica and slate powders. AUTHORS.

1002. Streaming Potential in Small Capillaries. H. B. Bull and L. S. Moyer. *J. Phys. Chem.* 40. *pp.* 9–20, *Jan.*, 1936.—Conditions in a membrane are considered in relation to the measurement of the streaming potential. In the derivation of the streaming-potential equation for small pore radii the equation for the potential between two coaxial cylinders is substituted for the plate condenser equations. Lens' modification of the thickness of the double layer in thin slits is introduced into this equation. The critical value of the radius is thus estimated. The results do not agree with those of Komagata. The change in the viscosity of water with capillary size is considered and the electrical *gegendruck* is compared with the mechanical pressure, a relationship being derived. A method for obtaining the average pore radius is developed and tested. The theoretical critical pore radius is compared with those found in diaphragms, but for quartz and glass the values do not agree. Anomalies are noted in the ζ-concentration and flow-concentration curves of quartz diaphragms with pores below the critical point; these curves are compared with those for cellulose, which behaves in a normal manner. P. H. B.

See also Abstract 957.

ELASTICITY AND PLASTICITY.

1003. Equilibrium of Thin Surfaces. L. Beschkine. *Comptes Rendus*, 201. *pp.* 935–937, *Nov.* 18, 1935.—The equilibrium of curved membranes subjected to normal and tangential stresses with their respective types of boundaries is discussed mathematically. J. S. G. T.

1004. Elastic Waves Produced by Applying Statical Force to a Body or by Releasing it from a Body. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 740–749, *Dec.*, 1935. *In English.*—General considerations regarding the application of a statical force to a body or the release of a body from this force are first treated and expressions are then obtained for the body as a whole or a localised part of it when acted upon in this way. It is shown that if the pressure is released very quickly, the energy applied to the origin is twice the value of the statical strain energy or equal to that of the wave energy transmitted to infinity. Wave energy cannot thus be evolved from the strained part of an elastic body even in sudden release of the force at the origin. Half of the value of the energy at the origin is, however, consumed in resolving the statical strain and the remainder is transmitted in the form of elastic waves to infinity. R. S. R.

1005. Buckling Load of Rectangular Plates. E. Trefftz. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 339–344, *Dec.*, 1935.—The determination of the stability of a square clamped plate with a uniform pressure round the edges is considered as an isoperimetric variation problem. The method is then applied to the case of rectangular plates with different pressures on each pair of edges. H. J. H. S.

1006. Bending of a Centrally Loaded Rectangular Strip of Plywood. H. W. March. *Physics*, 7. *pp.* 32–41, *Jan.*, 1936.—The deflection of a strip of plywood is calculated for the case in which the load is concentrated along a line through the centre of the strip and perpendicular to its edges. This type of loading is commonly used in tests to determine the effective modulus of elasticity in bending. Use is made of the differential equation for a flat plate of plywood. Explicit expressions in terms of the elastic constants of the component plies are given for the coefficients that occur in this equation. For the smaller span-depth ratios the flat plate theory does not lead to exact results. A method is given for calculating the appropriate correction to the results obtained on the basis of this theory. AUTHOR.

1007. Generalised Plane Stress. R. V. Southwell. *Phil. Mag.* 21. *pp.* 201–214, *Feb.*, 1936.—A flat plate of isotropic material, having uniform thickness, is stretched or bent by tractions applied to its edge and the configurations of equilibrium which these conditions permit are examined. Subject to specified restrictions the general solution of the equations of equilibrium and of compatibility of strains is obtained. The analysis leads to expressions for the stress-components involving the usual differentials of a stress function χ, and also differentials of a new function Φ which enters into the expressions for all five of the (non-zero) stress components. Apart from the introduction of Φ the solution has greater generality on account of new terms which enter into the expression for χ. The increase of generality which in consequence can be permitted in the specified distribution of the applied (edge) tractions is difficult and rigorous treatment is not attempted. Assuming that every one of the stress components can be expressed in a finite series of integral powers of z then it is shown that the occurrence in the solution of the function Φ does not permit a more general distribution of stresses than is obtained in the ordinary theory of plane stress unless the applied tractions are suitably related. R. S. R.

1008. Elasticity of Amorphous Materials in Relation to Their Internal Structure. R. Houwink. *Faraday Soc., Trans.* 32. *pp.* 122–143; *Disc.*, 143–148, *Jan.*, 1936.—Tensile strength and modulus of elasticity is discussed on a basis of cohesive forces of matter, as well as the most prominent theories on the internal structure of asphalts, resins and glass. The elastic properties of hardening resins are particularly studied, *e.g.*, a phenol-formaldehyde resin at − 195° C. has a modulus of elasticity of 1050 kg.mm.$^{-2}$ and a tensile strength of 7·8 kg.mm.$^{-2}$. A Lockerstellen theory is introduced in the case of resin macromolecules to explain why the tensile strength of a phenol-formaldehyde resin is about 1/550 of its theoretical value. A relation is shown to occur between the maximum amount of the elastic energy which can be stored up in a material and the energy content of the bonds. A high elasticity of up to 240 % is observed for hardening resins at about 120° C. and this is related to the formation of insoluble, elastic, three-dimensional networks. High elasticity, but only of the order of 10 to 20 %, is observed also for asphalts and glass. J. K.

1009. Plastic Deformation and Hardness of Lead. M. Ballay. *Comptes Rendus*, 202. *pp.* 222–224, *Jan.* 20, 1936.—Pb (99·984 %) is cast in a sheet 10 mm. thick, and rolled in three passes to 4 mm. Of this one portion (A) is annealed for 1 hr. at 250°, the other (B) kept at the ordinary temperature for 17 days, and the hardnesses (Δ) are compared. When pressure is first applied to the measuring ball both show approximately the same value of Δ, but after 5 min. application of the load Δ for B is appreciably less than that for A. This is probably due to the average size of the individual grains of A being about 1700 times as great as that of B. C. A. S.

1010. New Results and Methods in Vibration Theory. K. Klotter. *Zeits. f. techn. Physik*, 16. 12. *pp.* 561–565, 1935.—The development of the theory of mechanical vibrations during the last seven years is reviewed. The new methods may be described as the substitution of practically useful methods of solution for the more usual procedure of mechanics. This idea has been applied in its widest sense to the torsional vibrations of crank shafts and the vibrations of rods. The theory of successive approximations has also been worked out so as to lead to a better evaluation of the limits. During the period under review falls the progress of the so-called dynamical methods of test, that have given rise to a new branch of vibration theory. G. F. P. T.

1011. Transverse Vibration of a Square Plate with Four Clamped Edges. S. Tomotika. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 129. *pp.* 301–328, *Sept.*, 1935. *In English.*—Reference is made to the results obtained by Taylor and Weinstein [see Abstract 970 (1935)]. A similar method of treatment to Weinstein's is applied here, a modified minimal problem being taken. Applying the general principle in the calculus of variations that if in a minimal problem some of the conditions are made less stringent the minimal value in the modified problem cannot be greater than that in the original problem, a non-decreasing sequence of lower limits for the true minimal value of the non-dimensional quantity, $\rho h a^4 p^2/D\pi^4$ is calculated, where p is the frequency in 2π seconds of the fundamental mode, ρ the density of the material of the plate, a the length of side of the square, and D the flexural rigidity. The value now obtained $(3 \cdot 6461)^2 = 13 \cdot 2940$ is in good agreement with the value obtained by Taylor's method. R. S. R.

1012. Transverse Vibrations of Long Rods. I. A. Balinkin. *Phil. Mag.* 21. *pp.* 283–290, *Feb.*, 1936.—A simple theory, establishing a relation between the frequency of oscillation of a long blade, its size and elasticity, is developed. A unified theory is given for a vibrating long blade, one end of which is clamped, with its axis either horizontal or vertical. The frequencies are computed when the blade is either vibrating alone or with a concentrated load at its free end. Experimental results obtained with rods of steel, brass and wood agree well with the theoretical results. J. S. G. T.

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1013. Asymptotic Study of Damped Oscillations. J. Haag. *Comptes Rendus*, 202. *pp.* 102–104, *Jan.* 13, 1936.—A solution for self-maintained oscillations is reduced to the determination of cycles from the differential equation $xdx + (y - \lambda)dy = 0$, [see Abstract 87 (1935)]. To obtain damped oscillations λ must be multiplied by a large factor $1/\varepsilon$; if ε is small and approaches zero, the equation may be represented by straight lines parallel to OX and arcs representing λ. A short mathematical description is given of the method by which, dealing asymptotically with the curves, the cycles, periods and amplitudes of the oscillations may be obtained. If λ has many maxima and minima, the mathematics becomes very complicated. H. M. B.

1014. Form of the Tapering Flow Cone in Polycrystalline Test Rods with Various Loads. G. Seumel. *Zeits. f. Physik*, 98. 7–8. *pp.* 496–516, 1936.—In continuation of the research of Schiebold and Richter, the flow cones of six normal round rods of Al and Cu were examined from their formation after the exceeding of the highest load up to their breaking. A correction process is given by which the point angle can be correctly determined. It is proved that during the formation of the constriction the contour curves of the concave portion are not hyperbolæ: these occur under the conditions shortly after the absolutely highest load deviations between 20 % and 30 %. They diminish with increasing deformation till 2 % to 8 %. The convex portions of the contour curve form under the conditions a logarithmic curve; the deviations measured as in the concave portion are always under 1 %. The concave portion cannot be investigated up to the breakage, since through formation of holes in the interior which leads to the break, and as is shown by means of X-rays, the normal course of constriction is disturbed. It is however concluded, from the steady decrease of the deviation, that towards the break in normal course of the deformation a full agreement occurs between the measured and calculated contour. J. J. S.

1015. Influence of Shape of Cross-Section and Surface Condition on the Breaking Strength of Glass Rods. G. Schumann. *Zeits. f. Physik*, 98. 9. 10. *pp.* 605–609, 1936.—In this investigation it is shown: (1) That the average deviation of the values of the breaking stress of glass rods is influenced by the form of the cross-section; (2) That the

mechanical surface state leaves the material curve unchanged; (3) That a lowering of the surface energy by adsorbed liquids produces greater reflecting surface and lower breaking strength. H. H. Ho.

See also Abstracts 989, 1142, 1182.

GRAVITATION.

1016. Geodetic Potential. B. L. Gulatee. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 91–98, 1935. *In English.* — The determination of the earth's potential from a knowledge of the value of gravity at all points of the geoid is considered, and the process for reducing the values of g measured at the surface of the earth to their equivalent on the geoid is discussed. The process used by Hopfner, and his theory of determination of the potential therefrom, are criticised. The writer prefers the method proposed by Stokes for determining the potential at points in space external to the geoid from a knowledge of the gravity values on a level surface which includes all the attracting masses. E. L.-J.

See also Abstract 1120.

HYDRODYNAMICS AND AERODYNAMICS.

1017. Thermal Theory Applied to the Case of the Limiting Layer in Laminar Flow. G. Ribaud. *Comptes Rendus,* 202, *pp.* 32–34, *Jan.* 6, 1936.—The cases of the limiting layer in laminar flow along a plane, and for flow in a circular tube are treated mathematically by discussing analogous problems of heat flow. J. S. G. T.

1018. Motion of Fluids Accompanied by Changes of State. L. Kozlowski. *Acad. Polonaise Sci. et Lettres, Bull.* 5–6 *A. pp.* 244–252, *May–June,* 1935. *In French.*—The motion of a system comprising two fluid phases with a definite surface of separation, *e.g.*, a liquid and its vapour is discussed mathematically, the motion not being necessarily restricted to cases in which a velocity-potential exists, as in Natanson's treatment, but including also the case of vortex motion in the fluids. J. S. G. T.

1019. Stability of Viscous Fluid Flow under Pressure between Parallel Planes. S. Goldstein. *Cambridge Phil. Soc., Proc.* 32. *pp.* 40–54, *Jan.,* 1936.—The stability of viscous flow under pressure between parallel planes is discussed mathematically along lines introduced by Squire [See Abstract 5153 (1933)]. The motion is stable or unstable according as $I(\lambda/k)$ is negative or positive. The present work, partially connects up, numerically, for a particular value of k, a particular characteristic value of λ/k with an asymptotic approximation to these characteristic values for large values of q. In one method the numerical work has been carried out by Mallock's electrical calculating machine for the numerical solution of simultaneous linear algebraic equations, etc. J. S. G. T.

1020. Stability Problem in Hydrodynamics. C. L. Pekeris. *Cambridge Phil. Soc., Proc.* 32. *pp.* 55–66, *Jan.,* 1936.—The effect of two-dimensional first order disturbances on the linear and parabolic flows of a viscous fluid is discussed mathematically. The treatment is based essentially on Schrödinger's perturbation theory of wave mechanics, whereby a solution for finite values of Reynolds' number (R) is built up from the known solution for the case $R = 0$. J. S. G. T.

1021. Gliding of a Plate on a Stream of Finite Depth. Part II. A. E. Green. *Cambridge Phil. Soc., Proc.* 32. *pp.* 67–85, *Jan.*, 1936.—Numerical calculations are made for the case when the angle of incidence of the plate to the stream is 30°, the results for any other angle being similar. It is found that, for a given depth of stream and a given height of the trailing edge above the bed of the stream, the value of the lift increases with the length of the plate, until finally, when the plate is infinitely long, the lift assumes a maximum value. Further, for a given depth of stream, the total normal lift on the plate is independent of its height above the bed of the stream, when the length of the plate is small, except when the trailing edge of the plate is above the surface of the stream. Finally, when the depth of the stream is very large and the plate is near the middle of the stream, the solution approximates to the classical Rayleigh flow past a plate in an infinite fluid. [For Part I see Abstract 4843 (1935).] AUTHOR.

1022. Effect of High Viscosity on Flow Round a Cylinder. F. Homann. *Forsch. IngWes.* 7. *pp.* 1–10, *Jan.–Feb.*, 1936.—For the case of high viscosity the measurement of velocity with a Pitot-tube requires a correction for the dynamic pressure law. The results obtained for the effect of viscosity are in good agreement with the earlier results of Barker. With the aid of this correction the velocity field behind a cylinder is measured for three different Reynolds numbers. For the range R = 3 to 115 the results agree in essentials with those of Thom. In conclusion, the progress of the motion is discussed and the different conceptions introduced by various investigators are compared. G. F. P. T.

1023. Viscous Flow within Cylindrical Boundaries. W. Müller. *Ann. d. Physik,* 25.3. *pp.* 185–204, *Feb.*, 1936.—Solutions are derived for a number of cases of viscous flow. These include that of a liquid either within or surrounding a circular cylinder when the latter is suddenly moved with constant velocity in the direction of its axis, or rotated about its axis, either gradually, suddenly, or with uniform acceleration. The motion of a liquid enclosed by concentric cylinders which are rotated at different velocities is also determined, as is the laminar flow of liquids in a cylindrical tube under the influence of a constant, fluctuating, or periodically changing pressure drop. R. W. P.

1024. Vortex Systems. A. Masotti. *Acad. Lincei, Atti,* 22. *pp.* 429–432, *Nov.* 17, 1935.—Systems of free vortices in a plane layer are arranged so that a number of vortices of given intensity are situated at equal distances along the circumference of a circle, at the centre of which is a vortex of different intensity. Such a system and the motion set-up are not in general permanent. W. A. R.

See also Abstracts 946, 1122, 1131.

KINETIC THEORY OF MATTER.

***1025. Stern-Gerlach Apparatus. O. Specchia.** *N. Cimento,* 12. *pp.* 541–550, *Nov.,* 1935.—The construction and operation of a Stern-Gerlach apparatus is described, wherewith atomic and molecular rays may be produced and their behaviour in an inhomogeneous magnetic field may be examined. A method of determining the gradient of the magnetic field is introduced, based on the magnetic birefringence produced in a liquid. F. C. C.

1026. Kinetic Theory of Liquids and Diffusion of Light. J. Yvon. *Comptes Rendus,* 202. *pp.* 212–214, *Jan.* 20, 1936.—The diffusion of light by a liquid composed of rigid isotropic molecules is due uniquely to density fluctuations, and the molecular theory according to Rocard leads to Rayleigh's expression [see Abstract 768 (1936)]. The author points out that the above theory neglects change of wave-length due to molecular agitation and fluctuations of molecular field, while it simplifies in an arbitrary manner the rôle of refraction. In this paper the difficulties are solved by expressing the electrical moment of a diffusing molecule in a form analogous to that in electrostatics, and by deriving molecular distribution on the lines of classical statistical mechanics. Fluctuations of density are found not to produce any appreciable depolarisation of diffused light. The paper concludes with a theoretical discussion of the structure of a fluid which is almost in the critical state. [See Abstract 1318 (1936).] H. H. Ho.

See also Abstracts 981, 1253.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***1027. Moiré Micrometer. F. Burmistrow.** *Techn. Phys., U.S.S.R.* 2. 6. *pp.* 640–656, 1936. *In German.*—A description of an instrument using diffraction phenomena for the measurement of (*a*) thickness, and (*b*) structure of woven textiles. The idea is not new, such an instrument having appeared some years ago in Czecho-Slovakia. The present paper employs a photographic reproduction of an engine-ruled plate with a varying number of lines per in. from one end to the other. Such a plate is superposed on the silk stocking or other article to be tested and the shift and configuration of the interference lines is used for determinations of structure and thickness. The apparatus is described and its theory discussed. S. G. B.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

***1028. Automatic Recording Balance. D. S. Binnington and W. F. Geddes.** *Indust. and Engin. Chem.* (*Analytical Edition*) 8. *pp.* 76–79, *Jan.* 15, 1936.—An automatic, electrically operated, continuous recording balance fitted with oil damping and counterbalanced for an initial load of 100 gm. is described. Losses in weight up to 17 gm., with an accuracy in the order of 0·01 gm., are recorded without manual attention by means of an automatic device which places weights, in the form of steel bearing balls, upon the pan. Recording is performed, through the use of a timed spark, upon a paper chart carried on the drum of a variable-speed kymograph which has a range of from 12hr. to 6 days. AUTHORS.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

1029. Comparison and Critical Analysis of Physical Properties of Homologues and Isomers. G. Calingaert and J. W. Hladky. *Am. Chem. Soc., J.* 58. *pp.* 153–157, *Jan.*, 1936.—A graphical method is described for the critical comparison of data on any one of the physical properties of large groups of homologues and isomers. The illustration chosen covers the density (molecular volume) of the alkanes, and suggests the necessity of obtaining more and better data in the range C_9 to C_{12}. AUTHORS.

1030. Asymptotic Evaluation of Operational Expressions. S. Koizumi. *Phil. Mag.* 21. *pp.* 265–274, *Feb.*, 1936.—The Heaviside rule for the asymptotic evaluation of operational expressions is liable to lead to ambiguous or inaccurate results. It is shown that the asymptotic series, in the sense of Poincaré, of a function can be obtained from its operational expression by virtue of a slight modification of Watson's lemma, which was established to investigate expansions for the parabolic cylinder functions by the method of steepest descents. N. M. B.

1031. Ster and Stei Functions. N. W. McLachlan and A. L. Meyers. *Phil. Mag.* 21. *pp.* 425–436, *Feb.*, 1936. *Supplement.*—[See also Abstract 5255 (1934).]

1032. Integrals Involving Bessel and Struve Functions. N. W. McLachlan and A. L. Meyers. *Phil. Mag.* 21. *pp.* 437–448, *Feb.*, 1936. *Supplement.*

1033. Significance of Slopes and Other Parameters Estimated by Least Squares. W. E. Deming. *Phys. Rev.* 49. *pp.* 243–247, *Feb.* 1, 1936.—On the assumption that the errors of observation in both x and y coordinates are normally distributed at each point, and that the errors ϵ_a, ϵ_b, ϵ_c in the estimated parameters a, b, c of the empirical formula $F(x, y\,;\; a, b, c) = 0$ are also normal, it is found that the ratio $\epsilon_a\, w_a^{\frac{1}{2}}/\phi$ is distributed on a Student (Pearson type VII) curve. W_a is the weight of a, and ϕ^2 is the weighted sum of the squares of the residuals. When σ, the root mean square error of an observation of unit weight, is known, the test of significance is direct with the normal probability integral; when σ is not known the classical procedure is to use an estimate derived from the fit of the curve, and it is better to use the Student integral (the z test) rather than the normal integral (the u test). Some distinctions between the u and z tests are drawn and discussed. N. M. B.

1034. Maximum Precision of Gaussian Estimates in the Limit. D. Dugué. *Comptes Rendus*, 202. *pp.* 193–195, *Jan.* 13, 1936.—Fisher has given two propositions with very important applications, (*a*) the estimate supplied by the method of maximum likelihood is Gaussian in the limit and its type scale can be calculated, and (*b*) of all the Gaussian estimates it is that which supplies the minimum type scale. Dobb has provided a rigorous proof of (*a*), and in this paper a mathematical proof of (*b*) is supplied. R. S. R.

1035. Systems of Units of Measurement for Electricity and Magnetism. F. Odone. *N. Cimento*, 12. *pp.* 551–575, *Nov.*, 1935.—The principal formulæ of electricity and magnetism are stated in such a way that they may be valid in any system of units. It is thus found that it is necessary to introduce in addition to the primitive magnitudes of mechanics two new primitive magnitudes, one for electricity and the other for magnetism, and it is found besides that there appear in the formulæ 3 coefficients, depending on the units of measurement, connected amongst themselves by a remarkable relation. Depending upon the choice of the primitive magnitude for electricity (*e.g.* quantity of electricity) a numerical coefficient ϵ_0 must be introduced which must be determined experimentally. Similarly in the case of magnetism a numerical coefficient μ_0 must be introduced. If P is the power of a magnetic shell equivalent to a circuit with current i, $P = 1/\lambda_0 \times i$, where $1/\lambda_0$ is the coefficient of proportion giving the third of the coefficients mentioned, λ_0, the electromagnetic coefficient. Then it is found that $\lambda_0^2/(\epsilon_0/\mu_0) = c^2$, and has the dimensions of the square of a velocity, being thus independent of the choice of the magnitudes that are considered as primitive for electricity and magnetism and of the units of measurement chosen for these magnitudes. A review is given of the principal systems of units that are characterised by the way in which the primitive units are chosen, and by the values consequently acquired by the coefficients mentioned. Thus, there is finally the opportunity, or rather necessity, of defining in an analogous way the dielectric constant and magnetic permeability by a method which results in expressions destitute of dimensions. J. J. S.

1036. Definition of Magnetic Quantities. H. Abraham. *Soc. Franç. Élect., Bull.* 5. *pp.* 1233–1246, *Dec.*, 1935.—Up to the present the C.G.S. electromagnetic unit of magnetic field intensity has been termed the Oersted and the C.G.S. unit of induction the Gauss. In order to define the magnetic state at a point in space it is only necessary to know one local quantity, the induction B. Experimental results and formulæ representing them may be derived from the conception of this single quantity. The conventions underlying the present system of units is carefully analysed; it is pointed out that the μ of the formula $B = \mu H$ is not the same as that which occurs in the law of magnetic attraction. It is urged that the term Oersted and Gauss be no longer used as different names for one and the same magnetic quantity. [See following Abstract.] H. J. H. S.

1037. Characteristic Magnetic Vectors. E. Brylinski. *Soc. Franç. Élect., Bull.* 5. *pp.* 1247–1268, *Dec.*, 1935.—In opposition to the view of Abraham [see preceding Abstract], reasons are put forward to show that it is undesirable to dispense completely with the classical theory of magnetism and that the magnetic quantities B and H are separate entities. The ultimate particles of matter are envisaged as being present, not in space, but in a complex electromagnetic medium with which they constantly exchange energy. The treatment is based on classical theory and is given vectorially. H. J. H. S.

1038. M.K.S. System of Units. A. E. Kennelly. *I.E.E., J.* 78. *pp.* 235–244, *Feb.*, 1936.—[See also Abstract 462 (1936).]

1039. M.K.S. System of Electrical Units. R. T. Glazebrook. *I.E.E., J.* 78. *pp.* 245–248, *Feb.*, 1936.—[See also Abstract 462 (1936).]

***1040. Celluloid Spline for Drawing Curves. H. Osterberg and J. R. Roebuck.** *Rev. Sci. Instruments,* 7. *pp.* 12–13, *Jan.*, 1936.—It is stated that a good spline in which the curvature of an elastic strip is controlled by a plastic rod is much superior to any other method for drawing long curves of moderate and nearly regular curvature. The paper describes the construction in detail of three splines which have been found very satisfactory. They consist of celluloid strips attached to lead rods by a lacing of elastic cord. The details of the construction are illustrated. F. S. B.

***1041. Pointers of Low Inertia for Measuring Instruments. R. Miehlich.** *Zeits. f. techn. Physik,* 17. 1. *pp.* 27–31, 1936.—It is shown experimentally that glass is superior to aluminium as a material for constructing low-inertia pointers for measuring instruments. This is mainly because glass can be drawn down into the form of tubes with extremely thin walls, and a suitable method of performing this operation is described. Rigidity in the pointers can be maintained by combining together tubes of different thicknesses; at the same time, low moments of inertia are achieved. H. B.

See also Abstracts 1005, 1042, 1051, 1263, 1352.

MECHANICS, CLASSICAL.

1042. Invariant Measurements and Transitivity. N. Kryloff and N. Bogoliouboff. *Comptes Rendus*, 201. *pp*. 1454–1456, *Dec*. 30, 1935.—Mathematical. [See also Abstract 461 (1936) and following Abstract.] R. S. R.

1043. General Steady Movements in Dynamical Systems of Non-Linear Mechanics. N. Kryloff and N. Bogoliouboff. *Comptes Rendus*, 202. *pp*. 200–201, *Jan*. 13, 1936.—A dynamical system is considered whose state at any instant t is given by a point P $\{x_1 \, . \, . \, . \, . \, x_n\}$ of the Euclidean space E_n and whose movements are given by differential equations of the form $x_k = X_k(x_1 \, . \, . \, . \, . \, x_n)$ where $k = l \, . \, . \, . \, . \, n$. The moving point initially at P is given after a time t by T_tP. Then, as a special case of the problem considered earlier [see preceding Abstract] it is shown that $f(T_tP)$ possesses as a function of time a well-defined spectrum for all steady movement and that the spectrum remains the same for two movements belonging to a state of the steady *régime*. R. S. R.

***1044. Electromagnetic Control of High Rotational Speed. T. Davis.** *Rev. Sci. Instruments*, 7. *pp*. 96–98, *Feb*., 1936.—An apparatus is described in which the principle of the synchronous motor is used to maintain constant speed of the air-driven rotors described by Beams and Pickels [see Abstract 4478 (1935)]. The regulation is secured both with and without the use of an external driving circuit. The rotors are driven in synchronism with an oscillator when the driving air jets are completely turned off. AUTHOR.

MECHANICS, QUANTUM.

1045. Approximate Solution of Dirac's Equation by the Perturbation Method. G. Araki. *Tokyo B.D., Sci. Reports*, 3. *pp*. 1–16, *Dec*., 1935. *In English*.—The second-order equation obtained by iteration of Dirac's equations for the electron is solved approximately, the successive approximations involving successive powers of the fine structure constant. The external field is that due to any electrostatic radial field of force and the solution is carried up to the second-order terms. A similar treatment is given to Pauli's equation. G. C. McV.

1046. Coulomb Wave-Functions. F. L. Yost, J. A. Wheeler and G. Breit. *Terr. Mag*. 40. *pp*. 443–447, *Dec*., 1935.—The problem of the collisions of atomic nuclei with charged particles involves the exact consideration of the effect of the Coulombian repulsion between nucleus and incident particle. The solutions of the equations involved are tabulated and standardised, the cases for which the angular momentum of the incident particle is zero and unity being dealt with. The wave-functions for the particle inside the nucleus are also tabulated for the cases when the angular momentum has the values 0, 1, 2, 3, 4. [See following Abstract.] G. C. McV.

1047. Coulomb Wave-Functions in Repulsive Fields. F. L. Yost, J. A. Wheeler and G. Breit. *Phys. Rev*. 49. *pp*. 174–189, *Jan*. 15, 1936.—The wave-functions involved in nuclear reactions due to bombardment with charged particles are calculated by a more accurate method than has been hitherto used. These accurate values are compared with the approximations usually employed and the latter are shown to be crude for nuclear problems. [See preceding Abstract.] G. C. McV.

1048. Mysterious Number 137. M. Born. *Indian Acad. Sci., Proc.* 2*A. pp.* 533–561, *Dec.*, 1935.—In this lecture the author shows that all the finer laws of atomic physics are governed by the fine structure constant $1/a$, where $a = 137$, and discusses its deeper significance. The break-down of non-relativistic quantum theory is introduced through Bohr orbits, and Sommerfeld's work on fine structure, to the Schrödinger and Dirac wave equations. The interaction of electrons and radiation, and the Compton effect, are examined. The extreme smallness of the ratio of gravitational attraction to electrical repulsion between two electrons leads the author to discount the possibility of a unified field theory, but modern development of the early work of Mie on the modification of Maxwell's field equations leads to a unitary field theory regarding matter and field not as two entities but as one and the same, and eliminating the anomaly of "radius of an electron" or the infinite energy of the electron as a point charge. The unitary theory is, however, only a limiting case of quantum electrodynamics. This latter concept is developed from the electromagnetic field in empty space. Finally attempts are made to explain the constant 137 from the standpoint of the theories discussed. N. M. B.

1049. Self-Consistent Field with Exchange for Lithium. V. Fock and Mary J. Petrashen. *Phys. Zeits. d. Sowjetunion*, 8. 5. *pp.* 547–561, 1935. *In English.*—The method of calculation of the self-consistent field applied in a previous paper to Na [See Abstract 603 (1935)] is in the present paper adapted to Li. The improvement in the calculated energy values of the series electron resulting from taking quantum exchange into account is found to be very important. This is shown in the tables of the wave functions given for the normal and for four excited states of Li. The improvement of the calculated values of the transition probabilities by the inclusion of quantum exchange terms is investigated and discussed, the number of dispersion electrons being calculated. The results of the calculations are applied to the evaluations required for the formulæ for the fine and hyperfine lines of Li. J. J. S.

1050. Quantum-Mechanical Description. H. Margenau. *Phys. Rev.* 49. *pp.* 240–242, *Feb.* 1, 1936.—It is pointed out that, by removing a single quantum-mechanical postulate commonly accepted, several conceptual difficulties in quantum-mechanical description can be eliminated. [See Abstract 4483 (1935).] AUTHOR.

1051. Approximate Value of an Integral Occurring in Fermi-Dirac Statistics. C. W. Gilham. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 117–119, *Jan.*, 1936.

1052. Energy Distribution of States in a Simple Brillouin Zone. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 120–126, *Jan.*, 1936.—The energy distribution of states is calculated for the innermost Brillouin zone for a simple cubic lattice. The results are shown in a table and a diagram, giving the number of states per unit energy range as a function of the energy. The calculations are made primarily for the case in which the energy gaps in the free electron distribution are vanishingly small. The modifications resulting from finite energy gaps are considered, and the conditions for energy overlap of zones are discussed. The bearing of the results on the interpretation of the electronic properties of metals is indicated. AUTHOR.

1053. Statistical Disturbance Theory. Part II. P. Gombás. *Zeits. f. Physik,* 98. 7–8. *pp.* 417–429, 1936.—In Part I [See Abstract 99 (1936)] a disturbance calculus was developed which was based on the Thomas-Fermi theory but was not corrected for electron-exchange. This calculus is now extended by means of statistical theory to include electron exchange, and a statistical model is derived which enables the common treatment of neutral atoms and of positive and negative ions. Formulæ are derived for the electronic density to the first and second order terms in the disturbed atom or ion and for the disturbance energy to the first, second and third orders, and applications are discussed. Since only such quantities appear in these formulæ as can be evaluated from the theory, it is possible from the results obtained to determine important atomic constants by purely theoretical means without the aid of empirical or semi-empirical parameters. One application from the derived data is the calculation of the electrical dipole moment induced by an external electrical field in an atom or ion and a formula is derived for this effect. H. H. Ho.

1054. Thermal Properties of an Incompletely Degenerate Fermi Gas. N. F. Mott. *Cambridge Phil. Soc., Proc.* 32. *pp.* 108–111, *Jan.,* 1936.—Expressions for the specific heat and paramagnetic susceptibility of an electron gas obeying the Fermi-Dirac statistics at all temperatures, including those temperatures at which the gas is partially degenerate, are derived. J. S. G. T.

See also Abstracts 941, 942, 1058, 1089, 1171, 1346.

RELATIVITY AND ETHER.

1055. Control Observations of Lorentz Contraction by Level Readings. L. Courvoisier. *Zeits. f. Physik,* 97. 9–10. *pp.* 655–661, 1935.—The author's parallel level apparatus [see Abstract 3548 (1934)] was set up at Hanover, the levels being east-west, that on a fixed base to the south. The readings again showed a variation in a sidereal day, not explained by temperature, etc. The results of two series of observations by control observers, and the individual observations of one series, are given. The results are in reasonable accord with the author's interpretation by a Lorentz contraction of the earth due to its absolute translational velocity. The velocity derived is 623 km./sec. (previously 400, but the probable error is large) in direction R.A. 63°, Dec. + 41° (previously 75°, + 40°). T. L. M.

1056. Optical Relativity as Tested by Rotational Quality. J. Larmor. *Phil. Mag.* 21. *pp.* 160–163, *Jan.,* 1936.—Results established in the author's *Ether and Matter* (*pp.* 211–220), which were not in agreement with those of Lorentz, are now re-examined in greater detail and confirmed. C. B. A.

1057. New Relativity. Part I. Fundamental Principles and Transformations Between Accelerated Systems. L. Page. *Phys. Rev.* 49. *pp.* 254–267, *Feb.* 1, 1936.—A new approach to the relativity theory, suggested by the theory of E. A. Milne, is developed. This approach, like Milne's, dispenses with the concepts of measuring rods of undefinable rigidity and clocks of undefinable periodicity. A new category of equivalent relatively accelerated reference systems with Euclidean geometry and constant light-velocity is described, and the space-time transformation for such systems is developed. It is shown that in an effectively empty world Einstein's assumption of an invariant physical interval and an absolute four-dimensional space-time is in contradiction with the underlying principle of the relativity of motion, and therefore either the one or the other must be abandoned. AUTHOR.

1058. Linearisation of the Energy Density of the Electromagnetic Field. M. Born. *Cambridge Phil. Soc., Proc.* **32.** *pp.* 102–107, *Jan.*, 1936.—Employing the modified field equations proposed by the author, it is shown that linearisation or "Diracisation" of the energy density at a given point of space can be reached without introducing quantities other than those known from Dirac's electron theory. J. S. G. T.

1059. New Action Function and the Unitary Field Theory. L. Infeld. *Cambridge Phil. Soc., Proc.* **32.** *pp.* 127–137, *Jan.*, 1936.—A new form of the variation principle is given using the sum T of the Lagrangian L and the Hamiltonian $\mathscr{H}$ as an action function. This new form of the variational principle enables a new special action function to be found, which conserves the chief features of Born's theory while changing some of its former results. To a given charge correspond two static solutions with central symmetry, one giving a finite, the other an infinite energy. The potential of the one (light) particle is analogous to that in Born's theory while the potential of the other resembles a potential barrier. Also, by using the new action function, the symmetry between electric and magnetic fields ceases to exist. AUTHOR.

1060. Two-Centres Solution of the Gravitational Field Equations and the Need of a Reformed Theory of Matter. L. Silberstein. *Phys. Rev.* **49.** *pp.* 268–270, *Feb.* 1, 1936.—The solution with axial symmetry of Einstein's gravitational equations given by Curzon [*Proc. London Math. Soc.* **23**, *p.* 477] is rediscovered. It gives two singularities at rest relative to each other surrounded by empty space. It is urged that singularities of the field do not therefore necessarily represent material particles, for it is known experimentally that two isolated material particles cannot remain at relative rest. G. C. McV.

See also Abstract 1048.

SOLUTION.

1061. Properties of Metallic Solutions. W. K. Ssementschenko. *Acta Physicochimica,* **3.** 5. *pp.* 749–752, 1935. *In English.*—The possible chemical interactions in metallic solutions are simpler than those in dielectric solutions and the interatomic forces are more powerful and more homogeneous. A study of metallic solutions is undertaken in order to examine in a simple manner the general relationships of the dissolved state. The influence of the solute upon the surface tension is determined by the difference in the values, termed "generalised moments," which are given by the expression $m = \epsilon z/r$, where ϵ is $4 \cdot 77 \times 10^{-10}$, z is the valency of the ion and r is the radius of the ion; the ultimate value of the surface activity, G, is given by $G = RT\delta/1000 \times e^{\gamma(m_0 - m_1)}$, where γ is a constant depending on the properties of the solvent and the temperature and m_0 and m_1 are generalised moments of the solvent and the solute. From measurements on a number of amalgams, it is shown that the physico-chemical properties of a metal may be characterised by its generalised moments. H. J. H. S.

1062. Rate of Solution of Alkali-Boron Glass. R. L. Müller and C. V. Weinstein. *Acta Physicochmica,* **3.** 4. *pp.* 465–502, 1935. *In German.*—It is pointed out that the earlier view, namely, that there is for a given alkali concentration a coincidence between the beginning of the fall in the rate of solution and the increase in molecular conductivity, is erroneous and simply due to chance. The beginning of the increase of molecular electro-conductivity is a function of the composition while the beginning in the fall of the velocity of solution depends on physical solution conditions such as temperature and rate of stirring. J. K.

1063. Dipole Attraction and Hydrogen Bond Formation in their Relation to Solubility. J. H. Hildebrand. *Science*, 83. *pp.* 21–24, *Jan.* 10, 1936.—The development of the concept of the H bond is outlined. Data are given and discussed for a number of substances whose solubility is anomalous on the basis of dipole moment alone, but can be explained if account is taken of H bonds; thus nitrobenzene with 2·5 times the dipole moment of phenol is only 3 times as soluble in water as non-polar benzene, whereas phenol is 137 times as soluble. The solubilities, if due to electrostatic dipole attractions, should be of the same order of magnitude, but the alcohols, which can form H bonds with water, mix with it in all proportions. The anomaly is further illustrated by the deviation from Raoult's law of the total vapour pressure curves of CS_2 solutions, the solubilities of non-polar H_2 and N_2 and the polar, H bond-forming NH_3 in organic liquids, the freezing point lowering curves of naphthalene in organic liquids of different molecular fields, and the difference between association due to H bonds and that due simply to dipole attraction shown by curves of variation of molecular polarisation with concentration in solutions with non-polar components. N. M. B.

See also Abstract 995.

SURFACE TENSION AND COHESION.

1064. Evaporation of Small Drops and Relationship between Surface Tension and Curvature. J. L. Shereshefsky and Sylvia Steckler. *J. Chem. Phys.* 4. *pp.* 108–115, *Feb.*, 1936.—The rates of evaporation of *n*-dibutyl phthalate droplets ranging from 3μ to $0·5\mu$ in radius are measured in a Hoag type of Millikan's oil-drop apparatus under different conditions of vapour pressures. The data obtained are interpreted in two ways. One interpretation is based on an equation derived from Fourier's equation of diffusion; the results thus obtained show that the surface tensions of the droplets decrease with increasing curvature. The other is based on an equation derived on the basis of an assumption of a vapour film surrounding the evaporating droplet; the results obtained here lead to the validation of Kelvin's equation. An explanation is also given for the abnormally high values of surface tension obtained by Woodland and Mack [see Abstract 4579 (1933)].

AUTHORS.

1065. Drop Formation in Supersaturated D_2O Vapour. Surface Tension of D_2O. H. Flood and L. Tronstad. *Zeits. f. phys. Chem.* 175. *Abt.A.* 5. *pp.* 347–352, 1936.—The adiabatic expansion necessary for drop formation is considerably less for D_2O vapour than for H_2O vapour. The difference between the two critical supersaturations is small because the supersaturation of the D_2O vapour increases more quickly with increasing supercooling than that of the H_2O vapour on account of the greater heat of vaporisation. The surface tension of D_2O (approx. 99 %) measured between 12° C. and 50° C. by the maximum bubble pressure method was found to be greater than that of H_2O by an amount little greater than the accuracy (± 0·15 dynes/cm.) of measurement. The results obtained were successfully applied to a verification of the Volmer nuclear formation theory. P. H. B.

1066. Surface Tension of Molten Glass. W. B. Pietenpol. *Physics*, 7. *pp.* 26–31, *Jan.*, 1936.—The surface tensions of a number of different glasses are determined by the bulb method, similar to the soap bubble experiment in which the excess of pressure within the bubble can be balanced against a small head of liquid in a manometer. The weight of the glass bulb is taken into consideration. The method is applicable to approximately 200° C. above the annealing point of the glass. The variation of surface tension over the upper range of temperature is found to be of the order of 0·04 dyne/cm./°C. The surface tension for this range varies from 230 to 360 dynes/cm. depending upon the kind of glass. A survey of previous results discloses widely different values. One group of experimenters has obtained values of the order of 150 dynes/cm. and another group, values of approximately 400 dynes/cm. The results obtained by the bulb method fall approximately midway between. AUTHOR.

***1067. Ripple Method of Measuring Surface Tension. R. C. Brown.** *Phys. Soc., Proc.* 48. *pp.* 312–322, *March* 1, 1936.—An apparatus is described for the production, stroboscopic observation, and measurement of ripples for surface-tension determinations. The principal features are the use of a mirror attached to a vibrating reed as the means of obtaining intermittent illumination and a valve oscillator for actuating the dipper. Frequencies are measured by causing the oscillator to light an Osglim lamp which illuminates a stroboscopic disc attached to a phonic motor running at a constant speed. The dynamic quality of the ripple method is discussed and it is shown that the local change of area of the surface due to the passage of ripples would be expected to be negligible. Measurements of the fall of surface tension of a slowly adsorbed solution show that the method gives results similar to those obtained by a truly static method and it is concluded that the ripples have no retarding effect on the attainment of surface equilibrium. [See following Abstract.] AUTHOR.

***1068. Measurement of Amplitude and Damping of Ripples. R. C. Brown.** *Phys. Soc., Proc.* 48. *pp.* 323–328; *Disc.*, 329, *March* 1, 1936.—The optical arrangements of the author's ripple apparatus [see preceding Abstract] are such that determinations may be made of the amplitudes as well as of the wave-lengths of the ripples provided certain assumptions are made with regard to the wave-form. The fall of amplitude with distance of a maintained train of straight or circular waves is discussed, and the measurements taken show that the damping due to viscous forces causes a logarithmic falling off of amplitude. The damping factor is evaluated. In the case of circular waves the decrease of amplitude due to the spreading of the waves has to be taken into account. The amplitude of ripples which are satisfactorily observable is of the order of 2 or 3×10^{-5} cm. AUTHOR.

1069. Parachor, Surface Tension and Density of Substituted Phenols and Phenolic Ethers. A. Burawoy and I. Markowitsch-Burawoy. *Chem. Soc., J. pp.* 36–41, *Jan.*, 1936.—In continuation of previous work on the constitution of the so-called *o*-hydroxy-azo-benzenes, the parachors, surface tensions, and densities of the hydroxy-azo-benzenes and hydroxy-benzaldehydes and their methyl ethers are investigated.

They are discussed in relation to the same properties of the nitrophenols and anisoles as given among or calculated from Jaeger's data. The determined parachors of the *o*-hydroxy-compounds are low in comparison with the theoretical values and with those of the corresponding *m*- or *p*-hydroxy-compounds, but the methyl ethers in each series do not show these differences. This cannot be attributed to association. The results are further discussed in some detail. P. H. B.

1070. Parachors and Molecular Refraction of Hydrazine and Aliphatic Derivatives. L. D. Barrick, G. W. Drake and H. L. Lochte. *Am. Chem. Soc., J.* 58. *pp.* 160–162, *Jan.*, 1936.—The parachors of a series of aliphatic hydrazine derivatives are determined and calculated. The utility of Sugden's constants is demonstrated for these compounds. The molecular refraction of these compounds is determined and calculated. Satisfactory agreement is obtained provided certain unusual atomic constants for nitrogen are consistently employed. AUTHORS.

1071. Dielectric Potential at a Solution-Dielectric Interface. B. Kamieński. *Acad. Polonaise Sci. et Lettres, Bull.* 5–6*A*. *pp.* 309–318, *May–June*, 1935. *In English.*—On the basis of electrostatic and thermodynamical probability, a hypothesis is suggested that (1) small ions have little influence on the dielectric potential at the interface, solution-dielectric of smaller dielectric constant, for instance solution-air, (2) water dipoles are adsorbed from the air phase at the solution-air interface preferably, (3) great molecules and ions of weak electrolytes displace water dipoles at the said interface and weaken the negative charge of the water dipoles, as a consequence of the displacement. The hypothesis is in harmony with older and more recent measurement. As an example, the influence of the H-ions on the solution air interface is shown. The hypothesis is also in harmony with the fact that quinine salt solutions show a potential increasing with the pH of the solution. The potentials of 1/100, 1/250, 1/500 and 1/1000 *M* quinine solutions change from 17 to 464 mV, while the pH index changes from 2·4 to 9·6. The potential of a quinine solution of low concentration, namely 1/1000 *M*, amounts to 443 mV at pH 9·6. [See also Abstract 3332 (1935) and following Abstract.] AUTHOR.

***1072. Dynamical Method for Measuring Dielectric Potentials at the Solution-Air Interface. B. Kamieński and W. Goslawski.** *Acad. Polonaise Sci. et Lettres, Bull.* 5–6*A*. *pp.* 319–322, *May–June*, 1935. *In English.*—A simplified method for measuring dielectric potentials at the solution-air interface is described. The arrangement consists of a metallic tube, for instance, a copper tube moistened on the inside with an acidified solution of copper sulphate. The tube serves as a reference electrode. The inner jet consists of the solution under investigation which flows out of a separating funnel. [See preceding Abstract.] AUTHORS.

See also Abstracts **927, 1002, 1273.**

VACUA, HIGH.

***1073. Oil Manometer. O. Beeck.** *Rev. Sci. Instruments,* 6. *pp.* 399–400, *Dec.*, 1935.—Describes a composite oil and mercury manometer consisting of a fairly wide U-tube filled with an oil of low vapour pressure to a certain mark. By means of this mark the oil level in one branch can be set accurately to a definite position. The oil column rests on a mercury column, the height of which can be finely adjusted, and the movement of which is simply related to the pressure-difference to be measured. The accuracy and sensitivity of the instrument are claimed to be comparable with those of a good McLeod gauge. G. E. B.

***1074. Low-Pressure Manometers. H. Klumb and T. Haase.** *Phys. Zeits.* 37. *pp.* 27–32, *Jan.* 1, 1936.—After a survey of more usual methods of measuring high vacua, the author describes a series of manometers based on the heat-loss from bi-metallic strips. The strips used were of invar-constantan. In the simplest manometer a strip is mounted in a tube connected to the high vacuum, and carries at its lower end a fibre, the motion of which is measured by a microscope. In another type the strip is bent into a spiral and carries a mirror, which permits more accurate measurement, while in a third instrument a series of three spirals mounted in series give a movement sufficiently great to operate a pointer moving over a scale. The calibration curves of the manometers are given and show that the scale is substantially linear from 10^{-1} to 10^{-3} mm. mercury pressure. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

***1075. Determination of Viscosity by Oscillation of a Vessel Enclosing a Fluid. Part I. E. N. da C. Andrade and Y. S. Chiong.** *Phys. Soc., Proc.* 48. *pp.* 247–260, *March* 1, 1936.—The method of measuring the viscosity of a liquid by observing the damping of torsional oscillations of a sphere containing the liquid was originally put forward by Helmholtz and Piotrowski. The form in which they carried out and calculated their experiments is ill adapted to give good results, and actually led to false conclusions. A disposition of apparatus and a method of calculation are described which can be made to yield accurate results. This has been checked by determining the viscosity of water over a range of temperatures. [See following Abstract.] AUTHORS.

***1076. Determination of Viscosity by Oscillation of a Vessel Enclosing a Fluid. Part II. E. N. da C. Andrade and L. Rotherham.** *Phys. Soc., Proc.* 48. *pp.* 261–266, *March* 1, 1936.—A new method of carrying out the oscillating sphere method is described. The sphere containing the liquid carries a small permanent magnet, at the centre of a Helmholtz coil system. A condenser, discharged through the coils once in every complete swing, supplies the energy dissipated by the viscous forces, and so maintains a constant amplitude. Measurement of this amplitude, and of the potential of the condenser, enables comparative measurements of viscosity to be accurately made. The method has been checked by measuring the viscosity of hexane in terms of that of water. Absolute measurements are possible by the method, but have not been carried out. [See preceding Abstract.] AUTHORS.

1077. Viscosity of Liquid Gallium over an Extended Range of Temperature. K. E. Spells. *Phys. Soc., Proc.* 48. *pp.* 299–311; *Disc.*, 311, *March* 1, 1936.—On theoretical grounds measurements of the viscosities of liquids over as wide a temperature-range as possible are desired. Ga is particularly suited for this purpose, and the viscosity of the molten metal is measured between its melting point (approximately 30° C.) and 1100° C. This is a much wider range of temperature than has hitherto been recorded in viscosity-measurements. It has been necessary to devise a special technique on account of practical difficulties connected with surface films. At 1100° C. the viscosity decreases by only 2% per 100°. AUTHOR.

See also **Abstracts 938, 1002, 1022.**

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1078. Telescope Control. S. Watkins.** *El. World,* 105. *pp.* 32–33, *Nov.* 23, 1935.—The application of electrical equipment to control the rapid setting, accurate following of stars, and slow motion adjustments of telescopes is outlined. The application to a 15-in. photographic telescope, English mounting, is described in detail with photographs and wiring diagram. All the control circuits are brought through the lower pillar, polar axis and declination axis, with allowance for the motions of the instrument, to a six-button control block. The clock control, lighting circuits of the necessary index lamps, etc., are clearly shown. T. L. M.

***1079. Photographic Meridian Circle. B. V. Numerov.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 5. *pp.* 201–204, 1935. *In English.*—Images of artificial stars, east and west, are directed into the field by objectives mounted on the ends of the horizontal axis together with prisms secured in the central part of the cube. For photographic observations the plate-holder is driven at speed appropriate to the star's declination. Exposures up to several minutes are thus available and stars down to 11 magnitude may be used. The trails made by the artificial stars on the moving plate are interrupted by a contact clock. The theory of the instrument is discussed, together with the errors and their determination. A powerful meridian circle on these principles is under construction for Abas-Tuman Observatory. T. L. M.

***1080. Photoelectric Photometry at Harvard Observatory. W. A. Calder.** *Harvard Coll. Obs., Bull. No.* 405. [10 *pp.*], 1935.—A new electrostatic photometer was constructed in 1931, with a view to simplicity and portability; it is fully described. The mechanical parts are a distinct unit; the photometer may be interchanged rapidly with the plate-holder at the telescope without change of focus. Amplifier tubes have been used as they became available. A second stage of amplification is not so far advantageous. The instrument is now attached to the Wyeth 61-in. reflector. The tenth photographic magnitude is easily accessible. Numerous small-range variable stars have been found. The intensive observation of small groups of stars has been undertaken, to test for secular variation and for fluctuations in radiation (spottedness) in various spectral classes. Tests of constancy of radiation in six fields are reproduced; apart from probably variable stars, the probable error does not exceed 0·003 magnitude. In these differential measures, extinction produces only second order effects; the determination of extinction presents great difficulty. T. L. M.

***1081. Ultra-Luminous Spectrograph at the Pic du Midi. H. Garrigue.** *Comptes Rendus,* 202. *pp.* 44–45, *Jan.* 6, 1936.—Special characteristics of a large-aperture spectrograph for studying the light of the night sky are described, and results obtained with it are outlined. Lines at 5577, 5888 and 6300 Å were recorded with exposures of only 15 sec. C. B. A.

See also Abstracts **1097, 1114, 1115, 1117.**

COMETS AND METEORS.

1082. Origin of Comets. J. Larmor. *Observatory*, 58. *pp.* 316–321, *Nov.*, 1935.—It is shown that the hypothesis of an external origin of comets does not involve such a density of comets in space as would obstruct radiation to any appreciable extent, and that the same is true of isolated meteors in space; also that sensibly elliptic orbits would be produced in the case of external comets originally receding from the sun with velocities less than the parabolic limit. The distribution of observed orbits is thus interpreted favourably to the theory of external origin.
T. L. M.

1083. Comet Wolf I—Heliocentric Perturbations, 1919–1925. M. Kamieński and M. Bielicki. *Acad. Polonaise Sci. et Lettres, Bull.* 5–6 *A. pp.* 270–279, *May-June*, 1935. *In German.*—The perturbations during the close approach to Jupiter in 1922 are computed by the method of variation of constants of the heliocentric motion. A comparison with the Numerov method of numerical extrapolation in jovicentric coordinates gives very small residuals. Both these newer methods show less divergence than the classical method. A satisfactory connection of the earlier and later observations of this comet is therefore available. T. L. M.

1084. Widely Observed and Multiply Split Meteor. Dorrit Hoffleit. *Harvard Coll. Obs., Bull. No.* 901. *pp.* 3–7, *Dec.* 1, 1935.—The fireball of 1933, Dec. 14^d. 7^h. 35^m. $15^s \pm 20^s$ P.M., E.S.T. was photographed in North America, once at Oak Ridge, twice at Cambridge, and 30 visual observations in New England. These last were best for length of trail, and the photographs for detail; one showing the path as straight for 16° or 17°, the principal trail diverging 159″ and the fainter 282″ from the original trail; the average deviation of the straight path from a great circle being about 12″ on one plate and 6″ on another. The radiant of the straight path is $7^h\ 27^m\ 59^s + 33° 47' 10''$ near the mean position of Dennings radiant for the Geminids. The heights of initial and final points were 80·1 km. and (visually) 49 or 42 km. (photographically) above Pigeon Cove, Mass. and N.W. Worcester, Mass. respectively, but (visually) the initial point might have been over the sea. The distribution of the spindles were determined on two plates. A. S. D. M.

See also Abstract 1086.

COSMOGONY.

1085. Age of Galactic System. H. Mineur. *Comptes Rendus*, 201. *pp.* 710–711, *Oct.* 21, 1935.—If the masses of stars vary, the mean kinetic energy will also vary; considering two star groups of the same initial kinetic energy but different mean mass of the individual stars, the author shows that the equipartition of energy will be upset and that close approaches will have insufficient effect to restore it. There appears to be approximate equipartition of energy in the galactic system at present; it must have persisted since the formation of the stars; this imposes an upper limit on their age, of the order of 10^{10} years. This view is destructive of the stellar evolution theory. T. L. M.

See also Abstract 1048.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1086. Geocentric Distance in Laplace-Leuschner Direct Method for Parabolic Orbits. R. H. Sciobereti. *Lick Observat., Bull. No.* 476. *pp.* 127–160, 1935.—The paper gives in exhaustive detail the nomographic method already outlined by the author for the graphic determination of the geocentric distance [see Abstract 142 (1935)]. The three nomographs required are reproduced and several tables of auxiliary functions appended. Their use is illustrated from the three comets for which multiple solutions are known, also comet 1910*e*. A full mathematical consideration of the limiting cases gives the region of multiple solutions and shows why such cases are rare in practice. T. L. M.

See also Abstracts 1093, 1113.

LATITUDE AND LONGITUDE.

1087. Latitude Variation at Greenwich, Constant of Aberration, and Kimura Term. H. S. Jones. *Roy. Astron. Soc., M.N.* 96. *pp.* 122–131, *Dec.*, 1935.—The programme of observations with the floating telescope is described, with the arrangement of the star groups observed. The closing error found in the international latitude programme is discussed and it is shown that the systematic difference between morning and evening observations at Greenwich is closely analogous; the derived correction to the constant of aberration is therefore spurious. The observations are examined for terms of the form $f\ (\odot,\ \alpha)$ and a term $-\ 0''\cdot016\ \sin\ (\odot - \alpha)$ is obtained, which, along with wind effect, will satisfactorily account for the full amplitude of the Greenwich Kimura term. T. L. M.

See also Abstract 1093.

NEBULÆ.

1088. Proper Motion of Hind's Variable Nebula. E. Esclangon. *Comptes Rendus,* 202. *pp.* 21–22, *Jan.* 6, 1936.—The author compares the visual appearance and place (with respect to the variable star T Tauri) observed by d'Arrest in 1860, with photographs taken by F. Pease in 1913 and 1916; these show that the nebula is variable in form as well as in brightness. Plates taken in December, 1934, with 4 hours exposure at the Paris Observatory, Haute-Provence, by de Kerolyr, when compared with those of Pease indicate that it has an annual proper motion of $1''\cdot2$, and the appearances on all these plates confirm this change. But if this proper motion is extrapolated backwards to 1860, it is distant from the place then by $1'\cdot5$, indicating that the proper motion in the period 1913–1934 is about three times as great as in 1860–1913. The nebula's shape resembles that of a comet with two nuclei from which diverge (slightly) two tails, the direction of the tails being opposite to that of the proper motion. A. S. D. M.

PLANETS.

1089. Quantum Statistics and Internal Constitution of Planets. D. S. Kothari and R. C. Majumdar. *Nature,* 137. *pp.* 157–158, *Jan.* 25, 1936.—It is known that the radius of a stellar model consisting entirely of degenerate matter and which is no longer radiating, can be expressed in terms of its mass and the mean molecular weight of the free electrons present in the material. A method for calculating the dependence of the molecular weight on the mass is sketched using the idea that the ionisation of cold degenerate matter is determined essentially by its density or pressure. Taking the case when the material of the model is iron, a curve of mass against radius for "black dwarfs" of this type is found which agrees fairly well with the observed mass-radius curve for the planets. The general conclusion is that a planet is a "black dwarf" of mass less than about 0·001 the solar mass. G. C. McV.

1090. Equatorial Current of Jupiter. A. S. Williams. *Roy. Astron. Soc., M.N.* 95. *pp.* 723–725, *Oct.*, 1935. *Supplement.*—Rotation periods of the N. and S. equatorial current are derived from all available material for 1881–2, 1882–3, and 1892–3, amplifying and improving the velocity curve already given [see Abstract 1494 (1934)]. T. L. M.

1091. Approaching Disappearance of Saturn's Rings. P. Muller. *Roy. Astron. Soc. Canada, J.* 29. *pp.* 381–386, *Dec.*, 1935.—The author gives the three cases for which the rings disappear; (1) and (2) being when the earth or the sun is in the ring plane and (3) when the earth is on the side opposite to the sun, thus viewing the dark face. Diagrams show the altitude of the sun and earth with respect to the ring plane, the scheme of the last six phenomena of disappearance of the rings, and especially that of 1936–37, when in the first 2 months of 1937 the curve of the earth, instead of cutting the plane 3 times, has 2 intersections confused in a tangent point, the 3rd following much later. He gives the dates that should be remembered and especially the difficult ones for observation, during the period of continuous invisibility of the rings when the sun is below and the earth is above their plane. The observations to be made are of the condensations, brilliant or dark, on the ansae. A. S. D. M.

1092. Orbits and Perturbations of Minor Planets 1 to 1091, from 1801·0 to 1929·5. A. O. Leuschner. *Lick Observat., Publ.* 19. [519 *pp.*], 1935. (*Contributions of the Berkley Astronomical Dept., Students' Observatory, University of California. II.*)

1093. Secular Acceleration of the Moon. D. Belorizky. *Bull. Astronomique*, 9. 3. *pp.* 149–167, 1934.—The paper is a critical survey of the present state of the subject. The expressions for the mean longitude in the theories of Hansen, Newcomb and Brown are examined. The residuals demand an additional secular acceleration term, on which irregular variations appear to be superimposed. The studies of ancient eclipses by Fotheringham, Schoch, de Sitter, raise the secular acceleration almost to Hansen's value. Applying the tidal friction term, fluctuations remain. It is impossible to predict these to 1″. But de Sitter's hypothesis of sudden variations of the earth's rotation appears unsatisfactory. The author concludes that there are variable oscillations of the earth's crust, and that a definitive solution must await the development of geophysics. T. L. M.

See also Abstract 1113.

STARS.

1094. Error in Photographic Photometry. J. Lagrula. *Comptes Rendus*, 201. *pp.* 1025–1026, *Nov.* 25, 1935.—It is shown that in the photographic determination of stellar magnitude by Fabry's method of pupillary spots, various errors which result in small variations in the size of the spot can be corrected for by a single measurement of a dimension of each spot. The correction to the stellar magnitude obtained in this way is independent of the law of blackening of the photographic plate. W. S. S.

1095. Mean Stellar Parallaxes from Proper Motions. W. M. Smart. *Roy. Astron. Soc., M.N.* 96. *pp.* 132–144, *Dec.*, 1935.—The measures analysed are the total proper motions of the B.D. stars in eight groups of regions, obtained photographically at Cambridge. The method is the author's [see Abstract 1492 (1935)]. The distribution of total proper motions is shown for magnitude ranges : 7·0–8·9 ; 9·0–9·4 ; and 9·5 (B.D.). The correction for the effect of accidental error is discussed in detail, following two methods of Kapteyn and van Rhijn. The resulting mean parallaxes are tabulated according to the groups of regions, also according to magnitude and galactic latitude. T. L. M.

1096. Spectrophotometric Parallaxes of 205 G and K Stars. F. Becker. *Zeits. f. Astrophysik*, 11. *pp*. 148–151, 1935.—The author extends the derivation of absolute magnitudes and parallaxes from CN band intensity [see Abstract 4504 (1935)] to Kapteyn areas 164–206. T. L. M.

***1097. Interferometric Measurement of Double Stars with an 18-in. Refractor. R. H. Wilson.** *Frank. Inst., J.* 221. *pp*. 65–82, *Jan*., 1936.—This paper proves that an interferometer mounted on a moderate-sized telescope can be a useful instrument for measuring close double stars. By means of an auxiliary tube fitted into the filar micrometer of the Flower Observatory a double slit aperture forming the interferometer was supported 2 feet inside the focus of the telescope. The position angle of the slits could be read from the micrometer circle. From readings of position angles of minimum fringe visibility have resulted many accurate measures in position angle and distance of 44 double stars between 0″·1 and 0″·6 in distance and down to magnitude 7·5 in brightness. The interferometer more than doubles the resolving power of the telescope and greatly reduces the inconvenience of poor seeing. Its defects are a waste of light and susceptibility to errors caused by atmospheric dispersion. AUTHOR.

1098. Measurement of Apparent Stellar Diameters. A. Arnulf. *Comptes Rendus*, 202. *pp*. 115–117, *Jan*. 13, 1936.—The author applies the properties of diffraction fringes given by a point light source through a screen, and applies it to the case of a star occulted by the moon. At the moment of apparent occultation for the observer the shadow of the moon's dark edge is displaced on the earth's surface with a velocity of about 1 km./sec. If the star has no apparent diameter, the angular distance of displacement needed to substitute the first light fringe for the first dark is 0″·003, but if the star has one of this order, the disposition of intensities in the fringes is altered. He describes a photographic registration of the stellar image on a uniformly moving plate, the varying intensity of the image being analysed in a microphotometer. The Meudon Observatory obtained a successful registration for the occultation of Regulus on April 6, 1933, and this showed the first fringes clear and the light curves demonstrated that the diameter of Regulus must be less than 0″·003. A. S. D. M.

1099. Constants of Motion of F Stars. H. Camichel. *Comptes Rendus*, 201. *pp*. 881–882, *Nov*. 12, 1935.—The method of Mineur is used, as already applied to other spectral types [see Abstract 524 (1934)]. Residual velocities over 63 km./sec. are eliminated ; 475 stars are finally employed. The constants are tabulated ; in the Oort system, $l_0 = 346°$, in agreement with the accepted value ; A and B are about three times the accepted values, in agreement with results already derived by Mineur and others. T. L. M.

1100. Perseus Star-Stream. H. Schlöss. *Zeits. f. Astrophysik,* 11. *pp.* 117–131, 1935.—A stream velocity being assumed, its radial component for the position of any star is read from a nomogram; the star is further examined if the observed radial velocity departs not more than 3 km./sec. If the parallax is unknown the theoretical direction of proper motion is read from a second nomogram; the limit adopted is a departure of 20°. Forty-nine stars are added to the moving cluster; some of those included by Rasmuson are cut out. Their distribution as to proper motion, spectral type, and galactic coordinates is examined and fully illustrated. T. L. M.

1101. Limb Darkening. A. Pannekoek. *Roy. Astron. Soc., M.N.* 95. *pp.* 733–734, *Oct.,* 1935. *Supplement.*—The author's explanation of the deviation of colour temperatures from effective temperatures [see Abstract 2898 (1935)] has a direct bearing on the coefficient of limb darkening. In effect there will be again a variation with wave-length due to the variation of the absorption coefficients of the atmosphere. The values are tabulated. For type B, limb darkening is small, for A large in the blue, decreasing with larger wave-lengths, for G–K, smaller for blue than yellow. The sun again shows a discrepancy. The results may be tested on eclipsing variables. T. L. M.

1102. Time Factor in Spectrophotometry. W. M. H. Greaves. *Observatory,* 59. *pp.* 11–14, *Jan.,* 1936.—Describes the technique employed at Greenwich in making colour-temperature observations. The method of calibration is discussed at length. A. H.

1103. Internal Constitution of White Dwarfs. T. Araki and M. Kurihara. *Kyoto Coll. Sci., Mem.* 18. *pp.* 137–153, *May,* 1935. *In German.*—The paper contains extensions of Araki's theory [see Abstract 1040 (1935)]. The theory is generalised by extending the formulæ to include the case of relativistic degeneracy. Numerical calculations are given in some detail for the non-relativistic case and polytropic index $n = 1$, $0 \cdot 5$ and 0. The problem of " negative " energy sources and materialisation is considered in further detail. T. L. M.

1104. Stellar Evolution Theory. W. Nernst. *Zeits. f. Physik,* 97. 7–8. *pp.* 511–534, 1935.—The statistical evidence for stellar evolution is considered: sixty stars of known mass are tabulated by absolute magnitude; means by groups are also given; and the variation of temperature, mass, density, etc., shown to be regular. The relative frequency of star types gives indications of relative duration; the age of the earth's crust is employed to suggest a time scale. The order of the total energy evolved can then be derived. The greater part arises from processes of radioactive type; a part from the transformation of Li to He, etc.; a small but in some cases appreciable part from gravitation. The calculations apply to stars initially 20 to 40 times the sun's mass; there is some evidence, insufficient for detailed consideration, as to smaller objects. The decrease of stellar mass is considered at some length: the author does not accept the "heat-death" deduction from thermodynamics and suggests that disposable energy forms a sort of Brownian movement in the ether. Only a small fraction of the loss of mass appears to go into energy; but it is roughly proportional to the energy yield. The formation of white dwarfs might be due to an excess of neutrons arising with the destruction of mass. It is suggested that research into the non-relativistic destruction of mass would be fruitful. T. L. M.

1105. Number of Atoms above the Photosphere. A. Pannekoek. *Observatory,* 58. *pp.* 322–328, *Nov.,* 1935.—The "number of atoms" producing a spectrum line has a straightforward meaning only for absorption by interstellar gas or the atmosphere of a companion star. Within the star's own atmosphere the stream of radiation is obstructed by diffusion, *s,* but increased by ionisation, recombination, and collision (*k*) which throw black body radiation into the stream. The ratio *s/k* determines the line intensity. Hence the number N of atoms above the photosphere as used by Schuster and Unsöld is not applicable to modern conceptions of the stellar atmosphere. N describes the intensity of the line, not the concentration of active atoms, which must be computed from *s/k.* Russell's application of the oscillator strength *f* is subject to similar criticism.

T. L. M.

1106. Statistical Spectral-Type Distribution of Stars. P. Rossier. *Arch. des Sciences,* 17. *pp.* 373–378, *Nov.–Dec.,* 1935.—A discussion is given of the numbers of stars of different spectral types in a survey made at the Geneva Observatory. Hot stars are found to decrease in number proportionately, and cold ones to increase, with advance of spectral type.

G. C. McV.

1107. Variable Radial Velocity of δ Scuti. A. Colacevich. *Lick Observat., Bull. No.* 478. *pp.* 171–174, 1935.—The radial velocity of δ Scuti is found to be variable in a mean period, which in 1935 is equal to 0·19374 days. The amplitudes of the velocity curves obtained in the summer of 1935 varied between 7·4 and 12·4 km./sec. The form of the velocity curve is also variable. The systemic velocity curve may also be slightly variable, but further observations are needed before this may be considered as established. No changes in line width or spectral type during the period of velocity variation are apparent. The star belongs to the β Canis Majoris type.

AUTHOR.

1108. Photometric Study of δ Scuti. E. A. Fath. *Lick Observat., Bull. No.* 479. *pp.* 175–177, 1935.—δ Scuti is a variable star with a mean period of $0^{\mathrm{d}}.1938$. The amplitude of the light curve varies from $0^{\mathrm{m}}.23$ to $0^{\mathrm{m}}.15$. Apparently the variation in amplitude is periodic with a period equal to 26 times the light period. The time from maximum to minimum varies from $0^{\mathrm{d}}.100$ to $0^{\mathrm{d}}.123$ and from minimum to maximum from $0^{\mathrm{d}}.068$ to $0^{\mathrm{d}}.110$. Maximum light precedes minimum radial velocity by approximately $0^{\mathrm{d}}.023$. The amplitude of the velocity curve varies. Apparently this amplitude is correlated with the amplitude of the light curve. If the velocity curve represents a pulsation the radius of the star changes by approximately 100,000 km. when light changes are a maximum and by about half this amount when the light changes are a minimum.

AUTHOR.

1109. Pulsation Theory of δ Cephei Stars. M. Schwarzschild. *Zeits. f. Astrophysik,* 11. *pp.* 152–180, 1935.—Two objections to the pulsation theory are considered. One is that the light variation is not to be accounted for on the basis of the observed temperatures. It is here shown that the introduction of the departure of the radiation from black-body conditions produces agreement with the observed monochromatic-light variations. The other problem is the phase lag between light variation and radial velocity curve. The differential equations for radially symmetrical pulsations of small amplitude are set up without introducing the adiabatic approximation. Numerical integration is carried out for layers near the surface. Even with initial adiabatic conditions large departures arise for thin layers, with phase lags up to 30° for 1% of the radius. Using closer approximations, the development of the pulsation is studied for limited regions; approximately adiabatic pulsations can only be expected in, at the most, a limited region of the interior. The central singularity of the equations gives relations at the star's centre; but these do not define the pulsation conditions at the centre. T. L. M.

1110. Absolute Magnitudes and Parallaxes of Novæ. S. Gaposchkin. *Harvard Coll. Obs., Bull. No.* 901. *pp.* 7–10, *Dec.* 1, 1935.—Assuming that the brightness of a nova is due to expansion, and knowing the initial *or* maximum radius, the author determines the absolute magnitudes and parallaxes of 6 novæ (Gem 1912, Pic 1925, Aql 1918, Her 1934, Per 1901 and Cyg 1920), applying the Stefan-Boltzmann law of black body radiation, and comparing the results with those from trigonometric parallaxes, he obtains the formula: $M_{vis} = 10 \log (c_2 T^{-1}) - 5 \log R + 0{\cdot}93 + dm$, where dm is the bolometric correction. These calculated parallaxes are smaller than the trigonometric, and he concludes that either there is a great increase in surface brightness, which is improbable, or else the initial radius of these 6 novæ lies between 0·05 ⊙ and 0·65 ⊙ which, although much larger than the radii of the white dwarf B stars, is nearer to them than are the radii of most other stars. A. S. D. M.

1111. Photometric and Colorimetric Observations of Nova Herculis 1934. J. Ellsworth. *Comptes Rendus*, 202. *pp.* 28–29, *Jan.* 6, 1936.—Observations with a Cat's Eye photometer of Nova Herculis, made with three Wratten filters (clear yellow, green and orange) were compared with three BD stars + 43° 3892 (G type) + 46° 2426 (F_2) + 45° 2632 (Ao), the yellow giving the visual magnitudes (M_j) of the Nova, and the difference (C) between the green and orange filters serving as a Colour Index. The maximum brightness fell on Dec 22, 1934 ($M_j = 1{\cdot}0$); then the star fell by irregular oscillations till April 9, 1935; later the variations were more rapid. A curve of the C variations shows that its oscillations were feeble but follow closely those of M_j. C increases if the star becomes red. In June, 1935, the Nova became nebulous and its green and yellow light gave bright rays. A. S. D. M.

1112. Aberration of Light and Doppler Effect. K. Papello. *Zeits. f. Physik*, 98. 7–8. *pp.* 490–495, 1936.—Regarding the phenomena of the aberration of light which arise in double star systems and terrestrial objects it is established that the magnitude of the aberration, apart from the components of the velocity, is a function of the time. Hence it follows that the velocity or the wave-length of the light is dependent on the time. The aberration of light is different for a distant source of light from what it is for a neighbouring source. It depends on the absolute or relative velocity of the observer. The wave-length is a function of the time, yet the change of the vibration number according to the Doppler law is independent of the time. J. J. S.

See also Abstracts 1080, 1085, 1087, 1088, 1089, 1124.

SUN.

1113. Two Babylonian Eclipses. J. K. Fotheringham. *Roy. Astron. Soc., M.N.* 95. *pp.* 719–723, *Oct.*, 1935. *Supplement.*—The author examines the circumstances of two ancient eclipses, the times of which are recorded with more precision than usual. The corrections to the tabular difference between the mean longitudes of sun and moon are derived. The result is a very satisfactory confirmation of recent determinations of the relative secular acceleration of the sun and moon. T. L. M.

***1114. Selenium Rectifier Photo-Cell for Ultra-Violet Solar Radiation Measurements. R. Latarjet and G. Liandrat.** *Rev. d'Optique*, 14. *pp.* 443–448, *Dec.*, 1935.—A combination of a Se rectifier photo-cell with filters of silver on quartz is described. This responds only to a narrow band in the neighbourhood of 3200 Å, and in combination with a robust mirror galvanometer makes a convenient portable apparatus for the measurement of u.v. solar radiation. The spectral sensitivity curve and the intensity-current characteristic of the combination were measured. The results of solar intensity measurements at different altitudes (up to 4350 m.) are given. D. H. F.

1115. Measurements of Ultra-Violet Solar Radiation with Registering Spherical Cadmium Cells. M. Bender. *Phys. Zeits.* 37. *pp.* 107–110, *Feb.* 1, 1936.—When vacuum cells [see Abstract 2394 (1934)] in the form of two concentric glass spheres, with Cd on the outside of the inner sphere, are used for recording the u.v. rays of sunlight, it is noticed that the Cd distils on to the outer sphere. At first this was thought to be a heat effect, but later it was found to be due to u.v. light of wave-length 297 $m\mu$. Little deposit occurs for cells sensitive to shorter waves, but since these cells are insensitive to sunlight, they are useless. Thus vacuum cells give inconstant results. On the other hand argon-filled cells show little distillation of Cd, are very constant and sensitive. They are used with the recording apparatus by Hammer-Pychlau, and a diagram showing records on consecutive days in a town and on a mountain in July, 1935, demonstrates the greater intensity of the u.v. light received at the higher altitude in the purer air. H. M. B.

1116. Multiplet Intensities in the Solar and Iron Arc Spectra. C. W. Allen. *Roy. Astron. Soc., M.N.* 96. *pp.* 145–148, *Dec.*, 1935.—The intensities of certain iron arc multiplets in the solar spectrum are in disagreement with the theoretical intensities calculated for LS coupling. Five such multiplets are selected and their solar spectrum intensities are compared with their intensities measured in the spectrum of a 3-ampere iron arc. It is found that the intensities of solar and arc spectra agree much better with one another than does either of them with the theoretical values, hence it is concluded that the arc and solar intensities represent true line strengths. J. E. K.

***1117. Solar Magnetism. G. E. Hale.** *Nature*, 136. *pp.* 703–705, *Nov.* 2, 1935.—The evidence for the Zeeman effect in sunspots is summarised. To the law of uniform polarity in each hemisphere throughout the sunspot period there are about 3% of exceptions. The polarity alternates with each sunspot period. A complete 23 year cycle has now been observed. The author has now completed a second investigation of the general magnetic field of the sun. The measured displacement of lines does not exceed 0·001 Å. Repeated independent measurement has, however, verified the existence of a very weak field. A new type of measuring and recording machine has been constructed by R. M. Langer for this purpose. T. L. M.

See also Abstract 1101.

GEOPHYSICS.

GEODESY.

1118. Level Spheroid and the Principal Inertia Ellipsoid of the Earth. F. Ackerl and F. Hopfner. *Gerlands Beitr. z. Geophys.* 46. 1–2. *pp.* 1–31, 1935.—The expressions of Clairaut are generalised for application to the study of gravity values within a mass. The authors then proceed to the arithmetical calculation of the values of the flattening of the level spheroid, of the principal moments of inertia of the earth, of its mass, and of the potential values of the geoid. The work throws light on the undulation of the surface, and, compared with the level spheroid, shows that there has been a sinking under continental areas, and a rising under oceanic. W. A. R.

See also Abstract 1016.

GEOPHYSICS, APPLIED.

1119. H.F. Electrical Prospecting. V. Fritsch. *Beitr. z. angew. Geophys.* 5. 3. *pp.* 315–364, 1935.—The general problem of the transmission of h.f. and r.f. electric waves into ground, and the modifications in the reception due to geological and superficial conditions are considered, with special reference to previous literature on the subject. A summary of the current knowledge is given, and the writer adds details of his own experiences along traverses on the Czech State railways, on the Danube, in the Punkwa caves and in Kotterbach. The conclusion is drawn that all theories of transmission need very thorough checking by means of practical observations, especially of the absorption characteristics of various rocks and formations when the frequency of the wave is varied. Short waves appear to be transmitted more readily than long or medium waves. The author gives an extensive Bibliography of publications cited in the text. E. L.-J.

***1120. Thyssen Gravimeter. A. Schleusener.** *Beitr. z. angew. Geophys.* 5. 3. *pp.* 303–314, 1935.—Discusses the field accuracy of the Thyssen gravimeter, and its effective sensitivity as compared with the pendulum and torsion balance. In recent fieldwork, an accuracy as regards mean error of 0·2 milligal is claimed, *i.e.*, a probable error of 0·14 milligal, as tested by repetition of readings at the same point. The fluctuations in the readings on account of temperature are notably small, being only about 0·6 milligal per °C. The instrument is insulated, but not packed in ice, nor is a thermostat arrangement used. An outline of a test made in the summer of 1934 is given. The tests with the gravimeter revealed a discrepancy of 11 m.gal in results previously obtained by pendulum measurements; later pendulum observations confirmed the discrepancy. As a further test, twelve stations were " repeated " with the gravimeter at a week's interval. The differences from the earlier readings were, in the mean, 0·5 m.gal (probable error 0·35 m.gal, maximum difference in two repetitions 1·35 m.gal.). A second test compares the isogams obtained by 100 pendulum measurements, made by the Seismos Company in 1926/1927, with those obtained by the gravimeter in 1934 in the same districts. The isogams in the two cases were very similar, and both revealed details which were quite obscured in the records made prior to 1926 on the basis of the few pendulum stations then known. E. L.-J.

See also Abstract 1141.

HYDROSPHERE, PHYSICS OF THE.

1121. General and Secondary Circulation of the Oceans. H. Arakawa. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 43–63, *Dec.* 19, 1935. *In English.*—Extending former work [see Abstract 4161 (1935)], the general circulation of the ocean due to the distribution of the density of the sea-water and the secondary circulation produced by the winds are discussed. Although the magnitude of the vertical flow is found to be very small compared with the horizontal flow, the great effect of the vertical current is due to the fact that it rises, or sinks, over a very extensive area. The depth of reversal of horizontal flow in the case of general circulation is much greater than the depth in the case of circulation produced by winds. W. A. R.

1122. Uplift Pressure on Weirs. V. I. Vaidhianathan, G. Ram and E. M. Taylor. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 646–655, *Dec.*, 1935. —In previous publications [see Abstract 4162 (1935)] an account has been given of the estimation of uplift pressure on weirs built on permeable foundations, by means of the corresponding electrical potential distribution. This method is used to determine the pressure distribution under models of weirs when different lengths of sheet pile are introduced. The complete systems of equi-pressure lines and the variations of pressure at the ends of the sheet pile and the corners of the sheet pile and floor are given, together with charts showing the variations of pressure at the two latter points. The theoretical equations obtained by Weaver have been verified and are found to agree with experiment. G. F. P. T.

LAND, PHYSICS OF THE.

1123. Coefficient of Restitution of Rocks. Jeanne Roess. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 13. *pp.* 3–69, 1935.—The coefficient of restitution, ϵ, and Young's modulus, E, have been determined by the author's method and that of Oddone respectively for 41 different rocks. With certain exceptions E and ϵ vary similarly though not linearly. A method is then described for recording by photography the height of successive rebounds of the ball and for plotting these heights against the time at which they occur. It is thus shown that, though practically constant over a considerable range of heights of fall (and thus characteristic of the rock), for falls from smaller heights, the limiting height depending on the limit at which permanent deformation of the rock first appears, ϵ increases as the height of fall decreases, approaching 1 when this is 0. [See Abstract 1057 (1935).] C. A. S.

See also Abstracts 1140, 1141.

METEOROLOGY.

1124. Effect of Stratosphere Temperature on the Ozone Spectrum. D. Barbier, D. Chalonge and E. Vassy. *Rev. d'Optique,* 14. *pp.* 425–435, *Dec.*, 1935.—Absorption coefficients at $\lambda\lambda$ 3410–3100 of laboratory O_3 at 15° C. are compared with those of atmospheric O_3 as determined with the same objective-prism spectrograph [see Abstract 2025 (1935)]. The laboratory O_3 coefficients are obtained from a study of the absorption by a column of ozonised oxygen of the continuous radiation from a distant H_2 tube, which serves as an " artificial star." The atmospheric O_3 coefficients are obtained from studies of the O_3 absorption at the u.v. end of certain stellar spectra, two distinct methods being used : (i) determination of the coefficients themselves from the spectrum of Vega at several zenith distances during the same night, and (ii) determination of the differences between the coefficients for adjacent maxima and minima in several stellar spectra of types between B_0 and B_3. The comparisons show that the absorption spectrum of atmospheric O_3 differs from that of laboratory O_3 at 15° C., but resembles that at a lower temperature. This affords new proof that most of the atmospheric O_3 occurs in a cold region of the stratosphere. W. J.

1125. Turbulence with Heat Transfer. H. Schlichting. *Zeits. f. angew. Math. u. Mechanik,* 15. *pp.* 313–338, *Dec.,* 1935.—The stability of a stratified plane laminar motion is investigated by the method of small oscillations. The stability problem is reduced to finding the proper values in the differential equation for the vibrations. Calculations are carried out for a plate. The effect of turbulence is considered and reference made to the work of Richardson, Taylor and Goldstein. The essential assumptions of the theory are fulfilled in the experiments of H. Reichardt at Göttingen. A comparison of the theoretical and practical results shows good agreement. The importance of the conception of heat layers in meteorology is stressed. G. F. P. T.

1126. Lunar Atmospheric Tides over Canada. A. Thomson. *Roy. Astron. Soc., Canada, J.* 29. *pp.* 375–381, *Dec.,* 1935.—A method of determining the lunar atmospheric tide is described and values are quoted for Canadian stations and discussed. Two maxima and minima occur each day, the former when the moon is highest in the sky and the latter when on the horizon. There are also seasonal variations in time and amplitude. Since these fluctuations are only 1% of those accompanying weather changes the moon's influence on weather is negligible. The moon also produces small changes in the earth's magnetic field by raising and lowering the Kennelly-Heaviside layer, and alters the level of the maximum auroral frequency and also the level of the region with maximum brightness of meteors. R. S. R.

1127. Dynamical Study of Climate. L. Canellopoulos. *Comptes Rendus,* 202. *pp.* 150–151, *Jan.* 6, 1936.—For this investigation masses of air passing Lemnos during the period 1927–1934 have been examined from day to day and divided into different categories mainly according to origin. A table shows the number of days of each category. The monthly means of the temperatures of each category for the 3 winter months are also tabulated. Regular periods have been separated from non-regular and the properties examined independently. Some results so found are indicated and discussed. A. E. M. G.

1128. Halo Complex. H. B. Hachey. *Nova Scotian Inst. of Sci., Proc.* 19. 1. *pp.* 9–10, 1934–1935.—A halo complex occurred at St. Andrews, N.B., on March 4, 1935. In addition to the usual haloes of 22° and 46°, the parhelia of 22°, and the circumzenithal arc, an upper contact arc, inverted in type, of the 22° halo was observed. AUTHOR.

1129. Light of the Night Sky. G. Déjardin. *Rev. Modern Physics,* 8. *pp.* 1–21, *Jan.,* 1936.—The results of the various experimental and theoretical investigations of the light of the night sky are reviewed, from 1910 to 1935: visual and photographic measurements of its brightness; measurement of its polarisation; observations and interpretation of its complex spectrum over the range λ10000 to λ2963, and comparison with the polar aurora spectrum; its seasonal variations as observed at stations in different latitudes: theories of its origin; recent attempts to reproduce both its spectrum and the aurora spectrum in laboratory sources. W. J.

***1130. Wigand's Visible Horizon. F. Löhle.** *Phys. Zeits.* 37. *pp.* 22–27, *Jan.* 1, 1936.—The theory of the Wigand visibility meter and of other instruments on the same principle is examined critically and certain corrections are developed. Potsdam visibility observations with the Wigand meter are recomputed applying the corrections mentioned, and the derived curve of the distance of the visible horizon in different directions is found to accord better with theoretical anticipations. Similar corrections applied to Wigand's data give a visible horizon curve with one visibility maximum and one visibility minimum instead of the more complicated curve with five visibility extremes originally obtained.
W. S. S.

***1131. Use of Hot-Wire Anemometers. D. LeB. Cooper and E. P. Linton.** *Nova Scotian Inst. of Sci., Proc.* 19. 1. *pp.* 119–120, 1934–1935.—The constant temperature hot-wire anemometer must be used in the position of calibration when measuring very low air speeds. This is shown to be necessary on account of the difference in form of the calibration curves. The self-induced air currents vary with the position of suspension of the instrument. AUTHORS.

See also Abstract 1081.

SEISMOLOGY.

1132. Microseisms of Local Type. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 729–738, *Dec.*, 1935. *In English.*—Microseismic vibrations of local type are mainly formed by selective forced vibrations of the surface layers due to the pulsation of air pressure on the surface of the earth. The rigidities of the underlying strata are not very large compared with those of the upper layers.
W. A. R.

1133. Effect of Sharpness of Discontinuities on the Transmission and Reflection of Elastic Waves. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 750–762, *Dec.*, 1935. *In English.*—The investigations of Knott [see Abstract 1633 (1899)] and of Kawasumi and Suzuki on the reflection and refraction of waves at discontinuities in elastic bodies involved very sharp changes of density or elasticity. Probably the change is more gradual, and the transmission of waves under these conditions is considered. Knott's values are found to hold when the wave-length is large compared with the thickness of the intermediate layer. For shorter waves the amplitude of the transmitted waves is greater, and of the reflected waves is smaller, but for a certain intermediate range of thickness the respective amplitudes differ greatly as the wave-length alters. It is, therefore, difficult to ascertain the nature of discontinuities with the earth by comparison of amplitudes of different phases without regard to wave-length. R. S. R.

1134. Motion of the Surface of the Earth in the Compressional Phase of a Deep-Focus Earthquake. J. A. Sharpe. *Seismological*

Soc. of America, Bull. 25. *pp.* 199–222, *July,* 1935.—Methods of obtaining the displacement of the ground from seismograms are discussed, and it is concluded that the task is practicable. It is concluded that oscillation in seismograms is a result of reflections and transformations of primary waves within the crust. The average thickness of the crust beneath the stations, whose records were studied, is 32 km. W. A. R.

1135. Maximum Phases of Earthquakes : Direction and Variation in Amplitude of Vibrations. A. Dinca-Samuracas. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 12. *pp.* 5–99, 1935.—The times of arrival at the different recording stations of impulses that left the focus at the same time are determined. From the vertical and two horizontal seismograms a vector showing the actual direction and amount of movement of a particle at each station at a series of times are determined and plotted by wires of the correct length and direction affixed to a continuous wire indicating direction of propagation and time, of which photographs are given. This has been done for several earthquakes originating at or near each of Japan, the Kuril Ids., New Guinea and Central America as recorded at Strasbourg, de Bilt and Uccle. The results show that during periods of maximum movement the vibrations show rotation or polarisation to extents that appear to depend on the place of origin and of record, *e.g.*, rotation is more marked at de Bilt, polarisation at Strasbourg. The amplitude does not depend directly on the epicentral distance. At the same station the general appearance of the seismograms depends on the epicentre, being similar for earthquakes from approximately the same epicentral region. The movement indicated by an instrument on an isolated pillar is greater than that indicated by one solidly connected with a large building. C. A. S.

1136. Formula for Focal Depth of Distant Earthquake. H. P. Berlage. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques. No.* 12. *pp.* 105–108, 1935.—A revised calculation of the $pP - P$ difference shows it to $= 2h\sqrt{1/v_0^2 - 1/v_s^2}$, where h is the focal depth, v_0 the mean velocity of P waves in the crust immediately above the focus, and v_s that of the same waves at the distance from the focus of the station of observation. C. A. S.

1137. Aleutian Earthquake, 7th July, 1929. I. Lehmann. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 12. *pp.* 109–133, 1935. *In English.*—The European records of this earthquake are examined in order to trace the phase SKS at epicentral distances around 80°. This is not found possible, but time curves for this distance are worked out. The paper points out some defects in the instruments in use at European stations. W. A. R.

1138. Waves Produced by Distant Earthquakes. Jeanne Roess. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 13. *pp.* 71–146, 1936.—From the two horizontal seismograms the movements in the horizontal plane in (L) and ⊥ (T) to the direction of the epicentre are determined. From their resultant, $\sqrt{L^2 + T^2}$, and the vertical movement, V, from the vertical seismogram, the total movement $\sqrt{L^2 + T^2 + V^2}$, is deduced, and from these results the inclination to the horizontal of the total movement, $e = \tan^{-1} V/\sqrt{L^2 + T^2}$. From a consideration of L, T and e at suitable intervals according to the period of the wave under examination, the relative importance of the longitudinal and transverse waves at any instant is deduced. In this way, based on records of six earthquakes for which $\Delta = 36^\circ\ 07'$–$200^\circ\ 14'$, some 20 different varieties of wave have been examined. C. A. S.

1139. Energy Dissipation in Seismic Vibrations of Buildings. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 925–941, *Dec.*, 1935. *In English.*—The theory given earlier [see Abstract 4531 (1935)] is extended to the case of an n-storied structure with rigid floors and clamped base. The theory is studied in relation to three buildings of reinforced concrete having 3, 4 and 5 stories, and with very strongly constructed basements. It is found that the effective stiffness of a structure relative to the ground is of great importance, apart from such factors as acceleration of the uncovered ground, period of seismic vibrations, form of the structure, and materials employed in the structure and foundations. Stiffening the floors reduces the bending moments and stresses under resonance conditions rather than those in zero frequency of vibrations. Also although the live load affects the vibrations by increasing the bending moments in the vicinity of zero frequency, the same load under resonance conditions diminishes the bending moments. R. S. R.

1140. Tram and Building Vibrations. W. Bausch. *Zeits. f. techn. Physik*, 16. 12. *pp.* 593–597, 1935.—This research concerns the limits of human sensibility to vibrations. For a frequency range up to 15 $\sim$, the permissible limit of the acceleration is 15 cm./sec.^{2} With frequency increasing to 70 $\sim$, the acceleration limit goes to 80 cm./sec.^{2} Knowing the manner of propagation of these vibrations in free subsoil and in built-up streets, and these permissible accelerations, it is possible to determine the minimum distance buildings should be placed from a tramline—an important matter in planning new streets. W. A. R.

1141. Dispersion and Resonance Phenomena of Building Sites. R. Köhler. *Zeits. f. techn. Physik*, 16. 12. *pp.* 597–600, 1935.—Investigation shows that shear-waves, both of the stationary and of the compressional types, are useful for the investigation of the elastic properties of a building site. W. A. R.

***1142. Electrodynamic Vibration Recorder and Its Application to the Study of the Vibration of Buildings. E. Meyer and W. Böhm.** *E.N.T.* 12. *pp.* 404–414, *Dec.*, 1935.—This instrument, designed for low-pitched vibrations, normally measures the frequencies, but can be adapted to other purposes, such as recording the acceleration. It has been of great service in investigating the traffic-vibrations of buildings in Berlin. W. A. R.

***1143. Air Damper. T. Hagiwara.** *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 783–789, *Dec.*, 1935. *In English.*—The resisting force exerted by the ordinary air damper is calculated taking into consideration the compressibility of the air as well as its rate of flow between the piston and the containing cylinder, and the most suitable dimensions (by which the effect of compressibility is to a large extent avoided) for various rates of vibration of the seismoscope determined. C. A. S.

1144. Friction in Seismographic Lamp-Black Traces. J. Lacoste. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 13. *pp.* 167–193, 1935.—A summary of the theories relating to friction in seismographs given by Galitzin, Reid, Sohon, Hagiwara, Mohorovičić, Berlage and Gassmann is set out and various criticisms are made. Following the ideas of Mohorovičić as applied by Gassmann and Berlage, the author sought to find experimentally whether the residue of decay and friction can be deduced from lamp-black traces. He used (*a*) Gassmann's calculations, (*b*) Mohorovičić's calculations, and (*c*) Gassmann's residual formula. The results obtained with the Mainka, Wiechert horizontal and vertical, and Milne-Shaw seismographs are given. R. S. R.

1145. Mechanism of Earthquakes. S. Yamaguti. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 772–782, *Dec.*, 1935. *In English.* —An experiment is described which confirms the suggestion of Terada that if at the focus of a deep earthquake there is an expansion or a yield, the maximum shearing stress may occur at a conical surface with semi-vertical angle (at the centre of the sphere) of about 45°, and the fracture may propagate towards the surface along these directions. W. A. R.

***1146. Linear Strain Seismograph. H. Benioff.** *Seismological Soc. of America, Bull.* 25. *pp.* 283–309, *Oct.*, 1935.—A new type of seismograph is described. It measures the change in length between two fixed piers instead of recording vibratory movement. A rod is fixed to one pier, and the movement of its free end at the other affects the flux through a magnetic device. The movements are recorded by a galvanometer. Great sensitiveness is claimed for the instrument. The theory of its action is given. W. A. R.

***1147. Well-Gauge as Seismograph. F. B. Blanchard and P. Byerly.** *Seismological Soc. of America, Bull.* 25. *pp.* 313–321, *Oct.*, 1935. —Experimental and theoretical studies are made as to the possibility of utilising the changes of a well-gauge as a seismograph. Useful results can be obtained, but are subject to some uncertainties, such as changes in the amount of water in the well. More satisfactory would be a buried, sealed tank, fitted with a recording device. The pressure response would then be proportional to the velocity of the earth motion. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1148. Local Variation of the Earth's Electric Field. J. G. Brown. *Terr. Mag.* 40. *pp.* 413–424, *Dec.*, 1935.—Assuming that local diurnal-variations are small over the oceans, and absent over the polar ice during the winter night, a curve is adopted which represents the unitary diurnal-variation for a mean ocean-field of 129 V/m. The unitary variation at each land-station is found by multiplying the ocean-variation by the ratio of the mean land-gradient at each station to the mean ocean-gradient. By substracting these unitary variations from the observed mean curves the local diurnal-variations are obtained for 22 stations. Each local variation-curve is resolved into a 24-hour component, and a daytime depression-component. The stations fall into groups according to latitude, and the mean latitude-stations are of two types depending upon the amount of pollution. A theory is proposed which shows the significance of the components and accounts for the local diurnal-variation by the cycle of turbulence, convection, and subsidence which is present at all land-stations on all clear days. AUTHOR.

1149. Diurnal Variation of Intermediate and Large Ions at Washington. G. R. Wait and O. W. Torreson. *Terr. Mag.* 40. *pp.* 425–431, *Dec.*, 1935.—From continuous records of the intermediate and large ion contents, the authors find diurnal variations of the two sets which are similar. A pronounced maximum occurs for both about 21 h. local time. The variation in the intermediate ion content is proportional to that of the large ions, but this variation is less during times of higher, than during times of lower, large ion content. The large increase of intermediate ion content observed during thunderstorms is regarded, however, as probably due to the increased number of small ions at such times. It is felt by the authors that further investigation is necessary before the full significance of the similarity of the diurnal variation curves for the intermediate and large ion contents is apparent. They suggest, however, that particles of two different sizes are entering the atmosphere from a common source. Line diagrams illustrate the paper. A. E. M. G.

1150. Branching of Lightning from a Prepared Track. B. Walter. *Ann. d. Physik,* 25. 2. *pp.* 124–142, *Jan.*, 1936.—Photographs of lightning with a moving camera have shown that after the first discharge, a succeeding one may follow a track other than that already electrified, while others may return to the original track. Examples of such discharges are given and the effect is traced to the charge induced by the highly charged thunderstorm cloud on the earth or on another part of the cloud. For the earth after the initial flash distant parts of the induced charge may not reach the discharge point before the discharge ceases because of poor conductivity. The second flash may occur from the same point or it may occur direct between the distant point and the cloud. Similar effects may be observed with inter-cloud discharges. R. S. R.

1151. Electric Current-Systems of Magnetic Storms. S. Chapman. *Terr. Mag.* 40. *pp.* 349–370, *Dec.*, 1935.—Magnetic disturbance is due to electric current-systems above the earth's surface, and to secondary induced currents within the earth. The location of the external currents cannot be uniquely inferred from magnetic observations made at the earth's surface. Additional considerations are required to resolve this difficulty; knowledge of the distribution of ionised gas above the earth, such as radio observations afford, is one principal means, while another is the *a priori* probability that the current-system is fairly simple. The question whether or not the currents flow wholly in the atmosphere is discussed, and it is concluded, though not decisively, that the evidence favours this view. The strength of the various parts of the current-system is evaluated, and among other results it is shown that on days of moderate magnetic storm the total additional electric current flowing westward round the globe, between the North and South poles, rises to 750,000 A.
AUTHOR.

1152. Measures of Terrestrial Magnetic Activity. G. van Dijk and J. Bartels. *Terr. Mag.* 40. *pp.* 371–380 *and* 381–382, *Dec.*, 1935.—The statement of Bartel that " A break in the homogeneity of the international character-figures in recent years is discovered " is discussed by the first writer. By " recent years " the year 1930 is understood. While the international character-number C shows an increase from 0·672 in 1929 to 0·826 in 1930, the u and u_1 measures of magnetic activity indicate a small decrease. The numerical scale of classification proposed in 1906 was 0 = quiet day; 1 = disturbed day; 2 = very disturbed day, and many stations have adopted a system of fixed limits between the classes, but, although some modification of the systems took place afterwards, there was no reason for a change in the standard of classification in 1929 and 1930, and the stability of the character-figure is not in question

Different measures of the magnetic activity of a day are then fully discussed, and it is concluded that the results guarantee the stability of the mean character-number. Bartels in commenting on the foregoing points out that although the usefulness of the international character-figure C as a measure of magnetic activity for days and weeks is undisputed, its value for months and years is open to question, and it seems quite feasible to ascribe most of the discrepancy found for 1930 to the different conceptions of magnetic activity underlying the measures of C and *u*.
G. E. A.

1153. Summary of the Year's Work, Department of Terrestrial Magnetism, Carnegie Institution of Washington. J. A. Fleming. *Terr. Mag.* 40. *pp.* 385–392, *Dec.*, 1935.—A day-by-day record of terrestrial magnetism and solar activity in the form of a diagram demonstrating the 27-day recurrences in the 11-year cycle 1923—1933 has been published. The complete change in the character of the solar diurnal variations in vertical intensity observed at Huancayo during the past sunspot-cycle has been investigated. Work on the lunar magnetic variations at Huancayo has been done. This lunar wave, of harmonic amplitude 9γ, is the largest so far found for any observatory. Whilst the solar wave remains about the same during the year, the lunar wave decreases in the ratio 10 : 1 from December to June. This supports the assumption that the two waves originate in different layers of the ionosphere. The region of magnetic latitude 70° appears to be that of maximum auroral and possibly earth-potential activity as well as of magnetic disturbance. Studies of factors controlling the conductivity of the lower atmosphere, and of the small-ion, intermediate and large-ion content have been made. On balloon flights up to 27,000 ft., conductivities were registered which were 20 times as great as at ground level. Changes observed in the flow of earth currents are associated with variations in the inducing phenomenon. In ionospheric investigation a beginning has been made with continuous automatic single-frequency recording of ionospheric changes at Huancayo. Plans have been made for improved apparatus to be used in developing the work of the Department in nuclear physics. Other activities are concerned with magnetic surveys, observatory work and oceanographical reductions. It is noted that the British Admiralty decided in March, 1935, to build a non-magnetic vessel to continue the work of the Carnegie. [See Abstract 1085 (1935).] G. E. A.

See also Abstract 1004.

RADIOACTIVITY.

1154. Transformation of Energy. (Lord) Rutherford. *Nature*, 137. *pp.* 135–137, *Jan.* 25, 1936. *Watt Lecture before the Greenock Philosophical Soc.*—The author discusses the equivalence of mass and energy. Experiments are cited which verify that the destruction of mass involves the appearance of a corresponding amount of energy. The reverse process also occurs, since under certain conditions, pairs of electrons are produced by the action of h.f. γ-rays. In general, every type of reaction which is consistent with the law of conservation of energy can take place. It is not certain whether this law holds when light particles like positive or negative electrons are liberated in transformations. Possibly energy is carried off in some unknown form. This has given rise to the conception of the neutrino. R. W. P.

1155. Radiochemical Decomposition of Deutero-Ammonia. J. C. Jungers. *J. Phys. Chem.* 40. *pp.* 155–158, *Jan.*, 1936.—The rate of decomposition of ND_3 is compared with the rate of decomposition of NH_3 and found to be inferior, to rise more slowly with increasing temperature, and, at constant temperature, to increase with decreasing D_2 content. AUTHOR.

1156. Apparent Regularity in β-Ray Reflection. S. C. Curran. *Phil. Mag.* 21. *pp.* 406–415, *Feb.*, 1936. *Supplement.*—A source of β-rays is placed on the axis of a cylinder and the β-rays reflected from the surface of the cylinder are detected on a photographic plate placed perpendicular to the axis. A central spot surrounded by a ring, the dia. of which is independent of the nature of the cylindrical reflector, is observed. The pattern is not due to diffraction but to diffuse reflection rendered apparently regular by the geometry of the apparatus. The reflecting powers of different materials may be determined by direct photometric comparison of the intensities of the central spot and the reflection ring respectively. F. C. C.

1157. β-Ray Spectra of Induced Radioactive Elements Resulting from Neutron Bombardment. R. Naidu and R. E. Siday. *Phys. Soc., Proc.* 48. *pp.* 330–334, *March* 1, 1936.—A preliminary determination is made of the energies of the end points of the β-ray spectra of some unstable elements produced artificially by neutron bombardment, a cloud chamber being used. Although these energies are for the most part considerably higher than those encountered in natural β activity, they fit the Sargent curves fairly well. Between 4 and 10 % of the tracks observed are positively curved. No evidence is available to explain their origin unambiguously. AUTHORS.

See also Abstracts 934, 940, 1177, 1241, 1304, 1342, 1370.

RADIATION.

ABSORPTION AND TRANSMISSION.

1158. Ultra-Violet Absorption of Carbon Black, Gold and Rhombic Sulphur. G. Rathenau. *Physica,* 3. *pp.* 42–60, *Jan.,* 1936. *In German.*—The u.v. absorption by carbon black, gold and rhombic sulphur is studied by photographic photometry down to 1575 Å. An absorption maximum near 2500 Å and a minimum near 1700 Å are found for carbon black. Gold shows strong absorption near 1700 Å. Sulphur layers absorb beyond an absorption edge at 3500 Å. A new absorption band begins near 1800 Å. The results are discussed in detail and related with data from atomic and molecular spectra of the elements in question. AUTHOR.

***1159. Dyed Gelatin Light Filters. R. B. Withrow and H. M. Benedict.** *Am. Illum. Eng. Soc., Trans.* 31. *pp.* 69–80; *Disc.,* 80–81, *Dec.,* 1935.—Of the two possible methods of filtering radiation, that of molecular absorption, using solutions and coloured glass or dyed gelatin, has the most general application, because of simplicity and lower first cost. Brief details of the special characteristics of the different types of absorption filters available are given, together with the various classes of dyes suitable for use in gelatin filters, the stability of these dyes to heat and light being examined. Finally, spectrophotometric curves of a few typical filters having characteristics suitable for scientific and colour lighting work are given. In the *Discussion* **R. A. Palmer** asked for data on the transmission of u.v. radiation, and **L. C. Porter** asked for data on the infra-red transmission and temperature of disintegration or loss of purity. R. B. Withrow in reply stated that the results of dyed gelatin filters regarding u.v. radiation are, as yet, not very successful, but with infra-red radiations using 3 or 4 dyes in the same film the success has been considerable. With stable dyes a temperature of 160°–180° F. for 10 hr. a day for 3 months did not produce instability. R. C. F.

See also Abstract 1180.

COLORIMETRY.

1160. Variations in Colour Vision and Colour Measurement. R. A. Houstoun. *Phil. Mag.* 21. *pp.* 505–508, *Feb.,* 1936. *Supplement.*—A reply to a criticism by T. Smith [see Abstract 4952 (1935)]. The author points out that the choice of primaries in the C.I.E. colour system is such as to make it difficult for anyone but a specialist to understand the system. He further emphasises that it is possible for certain observers with a particular class of colour vision peculiarity (not detected by usual tests for colour blindness) to obtain incorrect results with a trichromatic colorimeter. He suggests the provision of suitable substandards of colour, such as could be provided by solutions of common salts when illuminated by Source A of the C.I.E. system. J. W. T. W.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1161. Kerr Effect in Nitrobenzol. F. Gabler and P. Sokob. *Zeits. f. techn. Physik,* 17. 1. *pp.* 11–17, 1936.—The paper gives a short review of the existing work and the principles of the method of measurement employed and a description of the method used for obtaining very pure nitrobenzol. The Kerr cell employed is of glass and stainless steel, and has no packing material. The band shift measured by a Babinet compensator is recorded both visually and photographically. At 20° C. for a wave-length interval of 5250–5800 Å the Kerr constant for nitrobenzol is determined as $B = 4{\cdot}04 \times 10^{-5}$ e.s.u. and the mean value of the conductivity is $k = 2{\cdot}5 \times 10^{-12}\,\Omega^{-1}\,\mathrm{cm}^{-1}$. R. L.

1162. Magnetic Rotatory Dispersion of the Alkali Mercuric Tetraiodides. R. Lucas and F. Gallais. *Comptes Rendus*, 202. *pp.* 129–131, *Jan.* 13, 1936.—Measurements of the magnetic rotatory dispersions of alcoholic solutions of the mercuric tetraiodides of the alkali metals (type K_2HgI_4) at wave-lengths in the visible spectrum show that the exceptionally high values of the Verdet constants and dispersion ratios of these compounds can be attributed entirely to the influence of their powerful u.v. absorption band at about 2900 Å. C. B. A.

See also Abstracts 947, 1218.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1163. Kathode Luminescence during Electrolysis. I. Uhara. *Chem. Soc. Japan, Bull.* 10. *pp.* 559–563, *Dec.*, 1935.—If the current density at the kathode is high enough for the formation of a thin film of H_2 in the electrolysis of the electrolyte solutions with Pt wire electrodes, considerably intense kathode luminescence takes place. The spectra are in most cases the same as the arc spectra (sometimes spark spectra) of the elements forming kations. Balmer lines of H and the molecular spectra of H_2 are often observed. AUTHOR.

*1164. **Application of Luminescent Screens to Glass Surfaces. W. H. Kohl.** _Canad. J. of Research_, 13. _Sect. A. pp._ 126–132, _Dec._, 1935.—An outline is given of the various methods for the application of luminescent screens, and their relative merits. Most widespread in use are methods that utilise a liquid binder that enters into a chemical reaction with the glass surface. In other cases, the powder is partially imbedded in the glass surface by a sintering process. The physical characteristics of the luminescent screen are adversely affected by both of these methods. A process based on the activation of the glass surface by a deposit of sulphur is described. The sulphur coating picks up the luminescent powder in a uniform layer when it is brought into contact with the powder. After being removed by means of a moderate heat treatment, it leaves the screen firmly adhering to the glass surface. Possible mechanisms for the process are briefly discussed. AUTHOR.

See also Abstract 1167.

INTERFERENCE. DIFFRACTION AND SCATTERING.

See Abstracts 948, 981, 1026, 1027, 1228, 1241.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1165. Photochemical Decomposition of Nitric Oxide. P. J. Flory and H. L. Johnston. *Am. Chem. Soc., J.* 57. *pp.* 2641–2651, *Dec.*, 1935.—The photochemical decomposition of NO is studied, as a function of the pressure, over the pressure range 0·02 to 7 mm. with irradiation both from the Hg arc and from sparks between electrodes of Al, Zn, Cd, Ni, Cu and Sn, respectively. The final products are N_2 and O_2, although the latter is removed during compression to produce a solid product, probably $HgNO_2$. The rate of decomposition is found to be directly proportional to the rate of light absorption for light of the effective wave-length and is, at very low pressures, directly proportional to the pressure. The effective Hg arc radiation is placed below λ1900, and, according to a water filter, in the neighbourhood of λ1830. J. K.

1166. Photochemical Decomposition of Gaseous Methyl Iodide. R. Spence and W. Wild. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 141–144, *Jan.*, 1936.—The products of the photo-decomposition of methyl iodide are analysed, and the quantum yield estimated. Addition of H_2 has practically no effect upon the rate in agreement with previous estimates of the collision efficiency of the reaction between CH_3I and H_2. No reaction could be detected between free methyl radicals and N_2O. AUTHORS.

1167. Sodium Resonance Radiation and the Polymerisation of Ethylene. J. C. Jungers and H. S. Taylor. *J. Chem. Phys.* 4. *pp.* 94–96, *Feb.*, 1936.—Ethylene is found to quench the resonance radiation of Na between 130° and 250° C. No measurable polymerisation of ethylene results as a consequence of quenching, in contrast to previous results with excited Hg and Cd. A catalytic polymerisation of ethylene at Na surfaces occurs above 250° C. with an activation energy of 20 k.cal. The inefficiency of the energy of sodium resonance radiation in producing polymerisation is ascribed to unfavourable localisation of the energy received by ethylene in the quenching process. AUTHORS.

1168. Properties of Photographic Plates Treated with Solutions of Sodium Salicylate. J. Terrien. *Comptes Rendus*, 202. *p.* 211, *Jan.* 20, 1936.—Recently Tien Kiu has shown that the factor of contrast of photographic plates treated with an aqueous solution of sodium salicylate does not depend on the wave-length between 2967 and 2482 Å. The author now shows that the above property is true for a much more extended spectral range, viz. to 1600 Å; also, that alcoholic solutions of sodium salicylate may be used, and are more advantageous in practice. The experiments were carried out with a spectrograph *in vacuo* optical fluorspar and variation of time of exposure, the source being a hydrogen discharge tube. The spectrum is photographed from 2600 to 1500 Å. H. H. Ho.

1169. Summation of Different Colour Radiations by a Photographic Emulsion. J. H. Webb. *Kodak Research Lab., Comm. No.* 574. *J.O.S.A.* 26. *pp.* 12–23, *Jan.*, 1936.—The problem of how a photographic emulsion sums different colour radiations divides into two parts depending upon whether the different radiations are applied simultaneously or successively. The first aspect was investigated by van Kreveld, who gave a simple theoretical law for the manner in which an emulsion adds different colours applied simultaneously. Results are presented here verifying this summation law. The major part of the investigation, however, deals with the addition of colours applied successively. A special technique had to be developed for these experiments and for the reduction of the data. The method of making the exposures consisted of crossing intensity scale curves, and the comparison of the separate and combination colour exposures was carried out graphically. The results show that an emulsion adds radiations of different colour (applied simultaneously or successively) according to the same rule that it adds radiations of identical quality. Van Kreveld's summation law was tested for the case of successive addition and was shown to hold in a restricted form here also. A. H.

1170. Graininess of Photographic Materials. E. M. Lowry. *Kodak Research Lab., Comm. No.* 572. *J.O.S.A.* 26. *pp.* 65–72, *Jan.*, 1936.—After briefly discussing a number of proposed methods for the measurement of graininess, it is shown that, whereas physical methods measure the granularity of the deposit, a subjective method is the only one which gives promise of direct interpretation regarding graininess. A new instrument is then described in which the magnification at which homogeneity ceases to exist with fixed viewing distance, is measured. Results obtained with this instrument on the effect of varying the field brightness and the effect of constant field brightness on the graininess of several different emulsions are given, the application of the results to the problem of graininess measurements being briefly considered. Finally, results on Callier's Q factor determination, together with a description of the apparatus used, are given, it being concluded that this Q quotient is not a suitable method of determining the graininess of photographic materials. R. C. F.

1171. Mathematical Construction of Photographic Blackening Curves. G. Ungar. *Zeits. f. Physik,* 98. 7–8. *pp.* 517–533, 1936.—It is shown theoretically that the number of quanta absorbed by each individual grain of a layer of grains of equal size and one grain thick is the same for each if the exposure is not too short; it depends only on the distribution of the absorbing places in each grain, whether these are developable or not. The coagulation theory of the latent image is developed mathematically on the assumption that each silver halide grain originates in some way from a number of cells, the size of which is determined by the average mobility of the photolytically produced electrons and that the total light quanta absorbed in such a cell contribute to the formation of a single aggregate of Ag atoms. A grain is developable if a sufficient number of light quanta are absorbed in one of the cells to produce a developing nucleus; an expression is derived for the probability that a given grain may be developed after absorption of Q quanta. The relation between grain size and sensitivity is examined and the larger grains are found to be the more sensitive. The Bose-Einstein statistics are applied to a consideration of the distribution of the absorbed light quanta by different grains for small exposures and a number of expressions are derived which may be used to deduce the blackening curves and their dependence on the nature of the emulsion. H. J. H. S.

See also Abstract 1189.

PHOTOMETRY.

See Abstracts 1080, 1159, 1173.

POLARISATION.

1172. Influence of Neutral Salts on the Optical Rotation of Gelatin. Parts III and IV. D. C. Carpenter and F. E. Lovelace. *Am. Chem. Soc., J.* 57. *pp.* 2337–2347, *Dec.*, 1935.—Experiments show that Hofmeister series of anions (I > Br > Cl) and of kations (Li > Cs > Rb > Na) exist with regard to their effects on the optical rotation of gelatin. In the absence of added salts, the rotations of the alkali gelatinates increase with atomic number up to K and then decrease. The rotatory dispersions of NaI solutions of gelatin in the visible spectrum can be represented by one-term Drude equations, the absorption frequencies in which coincide with the observed absorption at 2200 Å. The constants in the equations for various dilutions are simply related to the concentrations, and an explanation is suggested. Only two optically active species exist in gelatin solutions or gels. [For Part II, see Abstract 798 (1932).] C. B. A.

See also Abstracts 981, 987, 1228.

RADIATION, EMISSION.

***1173. Standard Source of U.V. Radiation for Calibrating Photoelectric Dosage Intensity Meters. W. W. Coblentz and R. Stair.** *Bureau of Standards, J. of Research*, 16. *pp.* 83–92, *Feb.*, 1936.—The advantages and disadvantages of sources emitting either a continuous or a discontinuous spectrum are considered in connection with the use of such a lamp as a standard of u.v. radiation. It is shown that because of the high intensity and favourable distribution of the u.v. emission lines at 2967 to 3132 Å, the quartz mercury-arc lamp is well adapted for standardising photoelectric u.v. dosage intensity meters in absolute units. A description is given of the installation of a commercial 110-V vertical quartz mercury Uviarc lamp, and of methods of calibrating its u.v. output in absolute units. By calibrating photoelectric u.v. intensity meters against a laboratory standard, a great reduction is effected in equipment required for field measurements of u.v. solar radiation. AUTHORS.

1174. Electromagnetic Waves from a Point Source. W. T. Howell. *Phil. Mag.* 21. *pp.* 384–398, *Feb.*, 1936. *Supplement.*—Hertz showed theoretically that a certain degree of variation of intensity of spherical electromagnetic waves over the wave-front is compatible with Maxwell's equations, and verified it experimentally. He further showed that variation of the amplitudes of the electric and magnetic force components along the wave-front is accompanied by deviations from the inverse first-power law of their variation with distance from the source, as well as by deviations of their phase-velocities from the velocity of light as ordinarily understood. A study of these deviations for spherical electromagnetic waves of the most general type is made in the present paper and some consequences of such deviations are noted. A. W.

1175. Ionisation of Kennelly-Heaviside Layer at Allahabad. G. R. Toshniwal and B. D. Pant. *Acad. Sci., Proc., U.P., India*, 5. *pp.* 9–14, *Sept.*, 1935.—Using the well-known pulse technique the ionisation of the E-region was found in the month of April. The morning and evening values, which are considered very reliable, show values for the critical frequency of 3·1 Mc./sec. and 4·6 Mc./sec. The latter being a maximum value observed at 7.22 p.m. on the 18th April. In an added note it is suggested that the use of higher power in the determination of the F_2 critical frequency would enable a discrimination to be made between the high-temperature theory of Appleton and the absorption hypothesis of Kirby and others. F. S. B.

1176. Cosmic-Ray Ionisation Measurements by Seven Meters at same Station. R. L. Doan. *Phys. Rev.* 49. *pp.* 107–122, *Jan.* 15, 1936.—The records of the different meters showed a statistical agreement. A barometer effect of 1–2 % per cm. Hg was found. A diurnal variation of intensity was found, the maximum being at 9.00 a.m. and being 0·19 % greater than the average. With the top shield removed the ionisation was greater during rainfall, presumably on account of active deposits brought down by the rain. The distribution in time of bursts was found to be random, and size-frequency distribution could be represented by a single exponential function. The existence of a barometer effect on burst frequency could not be proved. The frequency is a function of the shield thickness. D. H. F.

1177. Probability of Radiative Processes for Very High Energies. L. W. Nordheim. *Phys. Rev.* 49. *pp.* 189–191, *Jan.* 15, 1936.—The theory of radiation of electrons and pair-production by photons when passing atomic nuclei is adjusted so that better agreement with cosmic ray phenomena is obtained. G. C. McV.

1178. Magnetic Deflection of Cosmic Rays in the Equatorial Plane. L. A. van Wijk and H. Zanstra. *Physica,* 3. *pp.* 75–84, *Feb.*, 1936. *In English.*—Using Störmer's solution for the individual trajectories of corpuscular charged rays in the plane of the magnetic equator, the case of a vertical system of counters at the magnetic equator of the earth can be worked out completely, assuming the coincidences to be produced by primary rays. For cosmic rays originating from the Milky Way System, a large diurnal variation would remain, though the magnetic field tends to iron out differences. Thus the conclusion that rays reaching the earth's surface do not to a large extent originate from the Milky Way is substantiated. For eventual absorbing matter in the Galactic System the earth's magnetic field makes it harder to detect the absorption, the intensity decrement being divided by a factor of about 2½ for an absorbing strip of width 30°. AUTHORS.

See also Abstracts 1119, 1232, 1370, 1374.

RADIATION, GENERAL THEORY.

1179. Radiation Emitted by a Multipole and its Angular Momentum. W. Heitler. *Cambridge Phil. Soc., Proc.* 32. *pp.* 112–126, *Jan.*, 1936.—By expanding the radiation field in a series of spherical waves the complete expressions for the field emitted by an electric and magnetic $2l$-pole are obtained. It is shown that the wave emitted by a (electric or magnetic) $2l$-pole has an angular momentum about the z-axis $M_z = mU/v$ (U = total energy), where m, according to the orientation of the $2l$-pole in space, can assume the values $-l, -l+1, \cdots, +l$. The angular momentum is contained in that region of the field in which the product EH decreases as r^{-3}. By quantising the waves it is shown that the angular momentum of a light quantum emitted by a $2l$-pole behaves like the angular momentum of an electron in a central field of force without spin (commutation relations, etc.). The angular momentum of a single light quantum is an integral multiple of h. AUTHOR.

See also Abstracts 1154, 1241.

REFLECTION. REFRACTION AND DISPERSION.

1180. Decreasing the Reflection from Non-metallic Substances. J. Strong. *J.O.S.A.* 26. *pp.* 73–74, *Jan.*, 1936.—A method is described for the coating of optical surfaces with an evaporated (removable) film of a non-metallic substance. This cuts down the amount of reflected light and increases the amount transmitted. The effect is believed to be due to the new surface being covered with small pits which, compared with the wavelength of light, are too small to scatter light. Several applications are discussed. A. H.

1181. Simplified Theory of Image Errors. M. Herzberger. *Kodak Research Lab., Comm. No.* 558., *J.O.S.A.* 26. *pp.* 35–51, *Jan.*, 1936.—A simplification of Seidel's formulæ is given and there is presented a new method of tracing paraxial and finite rays through an optical system. The method is shorter, especially for machine computation, than the method generally used, and has the theoretical advantage that it deals only with optical lengths of paths. The method is developed from the designing formulæ usually used and the connection of the new image error formulæ with the old ones is indicated. A classification of the systems with a high degree of freedom from image errors is given and their characteristics are described. The investigation leads to a simple law which must be fulfilled in systems with sharp image formation. A. H.

1182. Refractive Indices and Dispersions of Volatile Compounds of Fluorine and Boron. K. L. Ramaswamy. *Indian Acad. Sci., Proc.* 2*A*. *pp.* 630–636, *Dec.*, 1935.—The refractive indices and dispersions of CF_4, NF_3, CHF_3, $(CF_3N)_2$, B_2H_6 and $B_3N_3H_6$, are measured at the ordinary temperature using a Zeiss interferometer of the Rayleigh type. The compressibilities of the gases mentioned are determined by studying the variation of refractive index with pressure. The atomic polarisations of these molecules are calculated from the dielectric and optical polarisations. It is found that the F compounds and the complex compound of boron $B_3N_3H_6$, have appreciable values of atomic polarisations. [See Abstract 306 (1936).] AUTHOR.

1183. Molecular Refractions and Molecular Volumes of the Glasses B_2O_3, $B_2O_3 \cdot xNa_2O$, $B_2O_3 \cdot xNa_2O \cdot yNaCl$. P. Wulff and S. K. Majumdar. *Zeits. f. phys. Chem.* 31. *Abt.B.* 5. *pp.* 319–342, 1936—Specimens of B_2O_3 containing various proportions of Na_2O are obtained by a special technique, completely free from water and in the form of rods free from double refraction. The apparent molecular volume of Na_2O deduced from the densities is strongly affected by the concentration, and approaches a limiting value at the concentration which corresponds with borax. The molecular refraction of Na_2O shows similar variations. B_2O_3 completely free from water has a lower density, higher molecular volume and higher molecular refraction than B_2O_3 with traces of water, which produce a contraction. The molecular volume of B_2O_3 in the presence of various quantities of $Na_2B_4O_7$ is constant, although lower than for alkali-free B_2O_3; but the molecular refraction varies with the addition of $Na_2B_4O_7$ in the same way as, but to a greater extent than, those of ions in aqueous solution. These deviations from additivity are regarded as a solvent effect, B_2O_3 being treated as a solvent with low dielectric constant. The molecular refraction and apparent molecular volume of NaCl dissolved in borate glass are lower than those of the crystals. C. B. A.

1184. Optical Constants of Crystals. R. G. Wood and S. H. Ayliffe. *Phil. Mag.* 21. *pp.* 321–336, *Feb.*, 1936. *Supplement.*—A method is described for the determination of the optical constants of small crystals by immersion in a suitable liquid, using a polarising microscope and a special microscope stage-goniometer. Results are given of measurements made on a number of organic crystals by this method. The following substances have been examined :—picryl *p*-toluidine (yellow form), picryl aniline, diphenyl either and diphenyl sulphone. A. H.

1185. Dispersion in the Ultra-Violet. M. Bayen. *Comptes Rendus*, 202. *pp.* 207–209, *Jan.* 20, 1936.—A parallel beam of known wavelength falls on a hollow prism containing the liquid under examination and the refracted beam is received on a photographic plate. The instrument is calibrated by means of liquids of known refractive index. Heptane and similar liquids are examined, the range covered being from $\lambda 5896$ to $\lambda 2265$. A. H.

1186. Dispersion of the Principal Indices and Axial Angle of Mica. E. Einsporn. *Phys. Zeits.* 37. *pp.* 83–88, *Feb.* 1, 1936. *From the Reichsanstalt.*—Two carefully selected specimens of East Indian mica are found not only to have very different refractive indices and axial angles, but also noticeably different dispersions of these quantities. It is concluded that mica is not suitable for use in precision measurements of phase differences. C. B. A.

1187. Disappearance of a Cause of Anisotropy in Glass on Annealing. J. Herbert. *Comptes Rendus,* 202. *pp.* 214–216, *Jan.* 20, 1936.—Anisotropy and zoned structure in window glass have recently been discussed by Gaubert [see Abstract 725 (1935)]. The phenomenon appears to be a joint consequence of chemical heterogeneity and the mechanical working processes. Data are given for the action of HF on several kinds of glass, this reagent giving a rigorous test for detection of zoned structure. On prolonged annealing (30 to 40 hr.) the zones are found to disappear, due to effecting a relief of the tensions which cause anisotropy. H. H. Ho.

1188. Theory of Microscope Vision. M. Herzberger. *Kodak Research Lab., Comm. No.* 573. *J.O.S.A.* 26. *pp.* 52–62, *Jan.,* 1936.—A survey is made of the different theories of microscope vision and a simple method is given by which these phenomena may be explained from a new standpoint. There is also given a short historical survey of the problems of microscopic vision. A. H.

***1189. Coincidence Distance Measurer. W. Kross.** *Phot. Indust.* 34. *pp.* 53–55, *Jan.* 15, 1936.—The advantages and disadvantages of this type of instrument are first set out. A relation has been shown previously to exist between the sharpness of the image and the distance of contours at the centre of the image but which do not cover the image. Here the optical basis for this relation is outlined. R. S. R.

***1190. Differential Refractometer. D. Rau and W. E. Roseveare.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 72–73, *Jan.* 15, 1936.—A differential refractometer is developed that uses white light and has a sensitivity of 5×10^{-7}. It is used to determine the concentrations of aqueous solutions with refractive indices from 0·0004 to 0·002 greater than pure water with an accuracy of 0·1 %. This corresponds approximately to 0·04 to 0·2 *N* NaCl solutions. The scale readings are nearly a linear function of the difference in refractive indices. Readings can be taken much more easily and rapidly than with the liquid interference refractometer. AUTHORS.

See also Abstracts 965, 967, 1070.

SPECTROSCOPY.

1191. Arc Spectra of Fluorine and Potassium. B. Edlén. *Zeits. f. Physik,* 98. 7–8. *pp.* 445–460, 1936.—The glow in a tubular graphite electrode packed with LiF or KF is examined in the region 5000 to 9600 Å with a grating of 4 m. radius. Of 85 F I lines, about 40 are new and have been identified with combinations involving $3p$–$3d$ transitions, not previously known in F I. In K I, four fundamental doublets and three groups in the associated sharp and diffuse series have been measured. Some CI lines have been measured in the infra-red and KI and CI lines identified in the solar spectrum. F. S.

1192. Absorption Spectra of Cerium, Neodymium and Samarium. F. W. Paul. *Phys. Rev.* 49. *pp.* 156–162, *Jan.*, 15, 1936.—A modified King electric furnace, charged with rare earth salts, is used to observe the absorption spectra of Ce, Nd and Sm in the region 12,000 Å to 2500 Å with a 21-ft. concave grating giving dispersion of 2·5 Å/mm. in the first order. The observations include 600 lines in Ce, 450 in Nd, and 1500 in Sm. In general the absorption data confirm the line types as given by King's temperature classification in that, of those lines which are absorbed, the class I lines are more strongly absorbed than class II lines, which are in turn stronger than class III lines, and provide additional data in that only those lines of each class which involve the lowest levels appear in absorption. AUTHOR.

1193. Extension of Thallium II Spectrum. C. B. Ellis and R. A. Sawyer. *Phys. Rev.* 49. *pp.* 145–150, *Jan.* 15, 1936.—The spectrum of Tl from the hollow kathode discharge in He is photographed in the region from 9250 Å to 600 Å. The classification of the first spark spectrum is approximately doubled by the assignment of 160 new lines, which locate 35 new levels. These include members up to $n = 11$ and 12 of the s, p, and d series (which establish the ionisation potential as 164,765 ± 5 cm.$^{-1}$), the first two members of the g series, and six levels of the $5d^9 6s^2 6p$ configuration. Perturbations are present in many of the series, due to their interaction with the $6p^2$ and $5d^9 6s^2 6p$ configurations. The $6s6g$ term appears to have hyperfine structure larger than its multiplet structure. Practically all of the hollow kathode lines of Tl in the entire spectrum have now been classified. AUTHORS.

1194. Regularities in the Spectrum of Trebly Ionised Iodine. S. G. Krishnamurty. *Phys. Soc., Proc.* 48. *pp.* 277–281, *March* 1, 1936. —The spectrum of a condensed discharge through iodine is photographed in the region λ6000 to λ1900 under varying conditions of excitation, and about 70 lines are ascribed to trebly ionised iodine. Among these more than 30 lines are classified ; assignments for the levels are suggested on the analogy of the other isoelectronic spectra, TeIII, SbII and SnI. AUTHOR.

1195. Intensity Measurements in the Neon and Argon Spectra Excited by Electron Collisions. O. Herrmann. *Ann. d. Physik*, 25. 2. *pp.* 143–165, *Jan.*, 1936.—The excitation functions and absolute emission values of numerous lines of the A and Ne spectra excited by electron impact are measured by an absolute method which by elimination of many common sources of error provides results of improved accuracy. Both the scattering of electrons and their angular distribution after elastic and inelastic collisions are taken into consideration. A detailed consideration of the scattering in Ne shows that by neglecting it very erroneous final results may ensue. The absolute emissions and excitation probabilities of 54 A lines are determined as well as the excitation functions of 52 A lines and 16 Ne lines. The absolute emission values of 7 Ne and A lines belonging to transitions between corresponding terms of the two spectra are compared and it appears that there is no regular correspondence between the values in the two cases. [See also Abstract 1219 (1936).] J. E. K.

1196. Absolute Transition Probabilities of Potassium. E. F. M. van der Held and J. H. Heierman. *Physica,* 3. *pp.* 31–41, *Jan.,* 1936. *In German.*—The absolute transition probabilities of the resonance-lines are determined by measuring the absolute intensity of the light emitted by K atoms in an acetylene-airflame, the determination of the flame-temperature (line-reversal method) and the number of emitting particles. A low-voltage K arc-lamp, the absolute intensity of which has been measured, is used as a standard light source. By photographic comparison with the help of an incandescent band-lamp, of which the colour temperature is known, the transition probabilities of the diffuse and sharp series are also measured absolutely. AUTHORS.

1197. Intensity Changes in the Fine Structure of the Balmer Lines H_α and H_β. B. Svensson. *Physica,* 3. *pp.* 91–104, *Feb.,* 1936. *In German.*—The intensity ratios I*k*/Il of the short to the long-wave components of H_α and H_β are measured by end-on observation of a discharge at different pressures (0·005 to 0·8 mm.) and currents (1 to 100 mA.). Different types of discharge give very different Ik/Il ratios in the transition region between striated and unstriated discharge. Side and end-on observations of H_α are compared. The variation in intensity of H_α, H_β and H_γ and of the lines 4617 and 4634 Å of the many-line spectrum across a striation is measured. In continuation of previous work at the same laboratory [see Abstract 3488 (1935)] some photographs are taken with the Lindemann apparatus at various electron velocities. A qualitative explanation of the results afforded by the different types of discharge is advanced. J. E. K.

1198. Atomic and Nuclear Moments. N. Dallaporta. *N. Cimento,* 12. *pp.* 576–595, *Nov.,* 1935.—A review is given of recent researches on atomic and nuclear moments from the experiments of Stern and Gerlach described in 1924 (which form the cornerstone of atomic magnetism) up till the present time. The experimental modifications of Rabi are described, as well as later measurements of atomic moments, and tables of the results obtained are given. The explanation of spectroscopic hyperfine structure by the existence of the magnetic moment of the atom, and theoretical difficulties met with, are discussed. Reference is made to the confirmation of the theory of nuclear moments by the Zeeman effect in the experiments of Goudsmit and Back, and a short account is given of the application of the method of Stern and Gerlach to the nucleus. A list of nuclear moments hitherto measured is given, though these are subject to notable uncertainties. J. J. S.

1199. Electrical Quadripole Moments of Certain Atomic Nuclei and the Magnetic Moment of the Proton. H. Schüler and T. Schmidt. *Zeits. f. Physik,* 98. 7–8. *pp.* 430–436, 1936.—The hyperfine structural terms of Eu and Lu are found to exhibit deviations of the Landé interval rule which cannot be explained by disturbances of neighbouring terms [see Abstract 3496 (1935)], and the cause is ascribed to the electrical charge of the nucleus being not spherically symmetrically distributed. In this paper, the elements Hg, Bi, Cu and As are investigated and their quadripole moments derived and discussed. Nuclei are found with lengthened and oblate distributions of charge and for the structure of the latter cases a simple representation is developed. The last-named leads to a value of $\sim 1\cdot5$ for the magnetic moment of the proton bound in a nucleus, which value is also supported by other facts so that it must be accepted that the magnetic moment of the free proton (~ 3) on incorporation in a nucleus sinks away to about 1·5. The decrease appears to occur gradually and not to be completed in the lightest nuclei; the cases chosen are ^2_1H, ^6_3Li and $^{14}_7N$, together with Al and Tl. H. H. Ho.

1200. Hyperfine Structure of Vanadium Multiplets. H. Kopfermann and E. Rasmussen. *Zeits. f. Physik*, 98. 9–10. *pp.* 624–637, 1936.—Investigations into the hyperfine structure of certain multiplets of the V I-spectrum have led uniquely to the value $I = 7/2$ for the mechanical moment of the V nucleus. H. H. Ho.

1201. Position of the Lowest Energy Terms of Deuterium. V. Rajewsky. *Phys. Zeits. d. Sowjetunion*, 8. 5. *pp.* 511–515, 1935. *In German.*—It is shown that the experimentally known position of the deuterium-ground terms (1^3S) establishes the ^3S-neutron scattering in H_2. By comparison with the experimental data of the ^1S-scattering and therefrom the position of the 1^1S-terms may be calculated. The splitting of the 1S-terms of deuterium is given to about $1{\cdot}7 \times 10^6$ eV. The ν-ray yield through proton-neutron collision is also investigated. H. H. Ho.

1202. Lower Limit of the Helium Ground-State Calculated by the Ritz Method. W. Romberg. *Phys. Zeits. d. Sowjetunion*, 8. 5. *pp.* 516–527, 1935. *In German.*—The Hylleraas calculations with respect to the approximation function are simplified. The inequality $\overline{\epsilon^2} \geqq \epsilon^2$ is shown to enable a series of lower limits to be determined, and application of the Ritz process gives another numerical series which can only converge towards the solution. The Weinstein formula does not provide as good an approximation as the one now derived, although both expressions are accompanied by the same difficulties. Generalisation possibilities are briefly discussed. The paper is mathematical throughout. H. H. Ho.

1203. Spectral Region of Radiation Emitted in Chemical Reactions. R. Audubert. *Comptes Rendus*, 202. *pp.* 131–133, *Jan.* 13, 1936.—The energies of the feeble radiations emitted during various chemical reactions are studied with the help of photo-cells sensitive only to selected parts of the spectrum. In some reactions, the radiations are detected by all the cells, but in 7 of the 14 cases which are tabulated, only one cell responds, so that the spectral range within which the radiations lie can be determined. C. B. A.

1204. Infra-Red Absorption of Organic Compounds Containing Hydroxyl and Imino Groups. L. Pauling. *Am. Chem. Soc., J.* 58. *pp.* 94–98, *Jan.*, 1936.—The infra-red absorption spectra of substances in CCl_4 solution obtained by Wulf and Liddell [see Abstract 4267 (1935)] are interpreted to lead to the following conclusions: (*i*) *o*-Chlorophenol exists in a *cis* and a *trans* form, the *cis* form being more stable than the *trans* by 1400 cal./mol., as a result of attraction of the partially shielded proton by the Cl atom. (*ii*) The catechol molecule has a *cis-trans* configuration. (*iii*) Proton attraction by O atoms also occurs in benzoin, ethyl lactate, etc. (*iv*) Pyrrole molecules exist in solution in a coplanar form, with the NH hydrogen in the plane of the ring, and in a non-coplanar form. Only the coplanar molecules of carbazole and tetraphenylpyrrole and the non-coplanar molecules of acetonylpyrrole occur in appreciable quantities. C. B. A.

1205. Infra-Red Absorption Spectrum of Liquid Methane. C. Corin and J. Herry. *Comptes Rendus*, 202. *pp.* 41–44, *Jan.* 6, 1936.—Eleven absorption bands between $0{\cdot}88$ and $2{\cdot}62$ μ are observed with liquid CH_4 or its solutions in liquid N_2. Their wave-lengths are almost identical with those of the gas, and they can be regarded as harmonics and as combinations of the four fundamental frequencies of the CH_4

tetrahedron. The intensities and positions of four bands between 0·88 and 1·38 μ are closely comparable with those of absorption bands of hexane. C. B. A.

1206. Near Infra-Red Absorption and Raman Spectra of Nitrogen Derivatives. Marie Freymann, R. Freymann and P. Rumpf. *J. de Physique et le Radium*, 7. *pp.* 30–36, *Jan.*, 1936.—A band at 1·04 μ is exhibited by amines and amides but not by ammonium salts, derivatives of hydroxylamine and hydrazine, amines of cobalt and copper. It is suggested that this may help materially in deciding the structure of certain nitrogen compounds. Similar discrepancies are experienced in Raman measurements on ammonium chloride, and the hydrochlorides of hydrazine and hydroxylamine. The influence of groups close to the NH is discussed. W. R. A.

1207. Effects of Isomerism on Infra-Red Absorption Spectra. W. Gordy and D. Williams. *J. Chem. Phys.* 4. *pp.* 85–87, *Feb.*, 1936.—The absorption spectra of four organic cyanides, two organic thiocyanates, and the corresponding isomers are studied in the region from 1·0μ to 6·5μ. The intense band appearing near 4·4μ in the normal cyanides appears at a longer wave-length and with doubled intensity in the isocyanides, the variation in wave-length and intensity being nearly constant for all compounds. In the case of the thiocyanates the variation in wave-length of the 4·6μ band for the two configurations is less than in the cyanides, whereas the intensity differences are greater. No other bands in these organic compounds are appreciably affected by isomerism. In the absorption spectrum of aqueous solutions of hydrocyanic gas there appears an intense band at 4·75μ and also a less intense band at 4·95μ. The band at 4.95μ can be attributed to a small amount of the isomer HNC. AUTHORS.

1208. Near Infra-Red Absorption Spectra of Acid and Basic Solutions. E. S. Barr and E. K. Plyler. *J. Chem. Phys.* 4. *pp.* 92–93, *Feb.*, 1936.—The infra-red absorption spectra of H_2O and aqueous solutions of HCl, HBr, NaOH, KOH, $ZnBr_2$, $ZnCl_2$ and Na_2CO_3 are measured from 1·5μ to 2·8μ. Bands are observed at 2·30μ and 2·45μ in hydroxides, at 2·30μ and 2·55μ in acids, and at 2·30μ, 2·45μ and 2·55μ in hydrolysing salts. The band at 2·30μ is produced by hydration and 2·45μ band by the OH ion. AUTHORS.

1209. Infra-Red Absorption Spectra of HCl in Benzene. E. K. Plyler and D. Williams. *Phys. Rev.* 49. *pp.* 215–217, *Feb.* 1, 1936.—The infra-red absorption of benzene and a solution of HCl in benzene is measured in the region from 2·5μ to 4·2μ. The absorption band of benzene at about 3·38μ is increased in intensity and shifted to longer wave-lengths in the solution for the same cell thickness. Other benzene bands in the region from 2μ to 3μ do not show an appreciable change in intensity or position. It is concluded that the absorption in the region of 3·4μ is due to the HCl in solution. When the ratio of the absorption of the solution to the absorption of the benzene is found, there appears a band with centre at about 3·49μ. The relation of the absorption to the dipole moment is discussed. AUTHORS.

1210. Absorption Band λ2700 of Chlorides in Aqueous Solution. Arlette Tournaire. *Rev. d'Optique*, 14. *pp.* 436–442, *Dec.*, 1935.—Absorption coefficients of aqueous solutions of HCl, LiCl, NaCl, KCl, $BeCl_2$, $MgCl_2$, $CaCl_2$, $SrCl_2$ and $BaCl_2$ between λλ3000 and 2400 are determined by photographic photometry with the H_2 continuum and a small quartz spectrograph (dispersion 30 Å/mm. at λ2700). All these chlorides have an absorption band between λλ2800 and 2600 with its maximum at λ2700, strongest in $BeCl_2$ and weakest in HCl. In HCl the band is stronger if the solution (14 mol./litre) is old than if it is freshly made. It is not detected in $AlCl_3$ and $FeCl_3$. The analogous band in bromides and iodides is at λ3000 and λ3500 respectively. In the case of LiCl, (i) as concentration is increased, the maximum absorption remains at λ2700 but slowly increases in intensity until concentration is about 11 mol./litre and then decreases; (ii) as temperature is raised from 20° to 100° C., the maximum absorption remains at λ2700 but becomes very slightly less intense; (iii) addition of even a trace of HCl solution of the same concentration causes an increase in the absorption coefficient over a wide range, the increase becoming about 100 % with equal volumes of the HCl and LiCl solutions. W. J.

1211. Absorption Spectra of TeO and TeO_2. Choong Shin-Piaw. *Comptes Rendus*, 202. *pp*. 127–128, *Jan*. 13, 1936.—Following up the examination of the spectra of selenium oxide [see Abstract 204 (1936)] a study is made of the absorption spectra of the oxides of tellurium. For low vapour densities bands due to TeO, *i.e.*, identical with TeO emission bands, appear between λ3100 and λ3300. Rotation structure is evident, and there is a suggestion of predissociation. For high vapour densities the absorption ascribed to TeO_2 is the dominating feature, and this resembles that due to SO_2 and SeO_2. There are three regions of absorption—from λ2930 into the Schumann region, continuous absorption; from λ2930 to λ4700, resolved into bands; absorption with a maximum at λ4980 and stretching to the red, again resolved into bands. The third absorption region is only visible at temperatures above 1250° C. The bands are diffuse, but a few show sharp heads and these degrade to the red. Two periodicities (650 and 210 $cm.^{-1}$) have been detected. A. H.

1212. Absorption Spectrum of Cl_2O_3. M. Kantzer. *Comptes Rendus*, 202. *pp*. 209–210, *Jan*. 20, 1936.—Previous work has not succeeded in differentiating the spectrum of Cl_2O_3 from that of ClO_2, whence the existence of the former as a definite molecule has been doubted. Evidence is presented supporting the existence of Cl_2O_3 in that this gives an absorption spectrum consisting of a continuum from λ3500 to λ4260, and of discrete bands from λ4260 to λ4650, whilst the spectrum of ClO_2 under identical conditions shows bands ranging from λ3900 to λ4180. A. H.

1213. Absorption Spectrum of Sulphur Trioxide. E. Fajans and C. F. Goodeve. *Faraday Soc., Trans*. 32. *pp*. 511–514, *Feb*., 1936.—A determination is made of the absorption spectrum of SO_3, special precautions being taken to ensure purity of the SO_3 and absence of SO_2. The spectrum is observed from λ3000 to λ2200. The observed diffuse bands are of an unusual type, the maxima of absorption being flat and the minima sharp. The distance between the minima is approximately constant and equal to 430 cm^{-1}. A. H.

1214. Ultra-Violet Spectrum of Ammonia. Part II. A. B. F. Duncan and G. R. Harrison. *Phys. Rev*. 49. *pp*. 211–214, *Feb*. 1, 1936.—Seven bands of NH_3 between 1620 and 1450 Å are photographed in absorption with a dispersion of 1·3 Å/mm. These are the 0,2–0,8 bands of the second electronic state above the normal. Each band has one P and one R branch, and a broad intense line as a Q branch. Within the limit of observational errors, which were large in this region, the moment of inertia A′ is only slightly larger than A″, and C′ is about equal to C″, so that the dimensions are not greatly changed in the excited state. [For Part I see Abstract 3053 (1935).] AUTHORS.

1215. 11·6-Volt Predissociation Limit of CO. R. Schmid. *Phys. Zeits.* 37. *pp.* 55–56, *Jan.* 15, 1936.—The weakening at $v' = 0$, $J' = 29$, of the lines in the $C^1\Sigma \rightarrow A^1\Pi$ bands of CO indicates a predissociation limit at 93500 cm.$^{-1}$, or 11·6 V, above the lowest level of $X^1\Sigma$ [see Abstract 4592 (1935)]. This is supported by the fact that neither these nor the "3A" bands $c^3\Pi \rightarrow a^3\Pi$ have $v' > 0$, since $C^1\Sigma$ and $c^3\Pi$ lie at 11·34 and 11·36 V, and will have $\omega = 1500$ to 2000 cm.$^{-1}$ (0·2 to 0·25 V). It is now confirmed by heavily exposed spectrograms of the "3A" bands recently obtained with a 6·5 m. grating of highly-reflecting Hockheim alloy (first-order dispersion 1·2 Å/mm.). These, too, show weakenings in their several branches ; and, although their rotational analysis is not yet effected (on account of strong overlying fourth positive bands), it is possible to estimate $B_0' - B_v''$ and hence B_0' ($\doteqdot 1·9$ cm.$^{-1}$), B_v'' being already known from the third positive bands. The estimated positions of the cuts of $c^3\Pi$ by the 11·6 V limit agree with the observed weakenings in the "3A" bands. Herzberg notes that the author's identification of the 0·48 V and 0·54 V separations of the predissociation limits and the atomic levels respectively is outside observational error limits, and that both predissociations must be associated with one dissociation process, the cuts of $C^1\Sigma$ curves by the 11·6 V limit being well above the asymptote, as in N_2 [see Abstract 1648 (1935)]. W. J.

1216. Strontium Deuteride and Hydride Spectra. W. W. Watson, W. R. Fredrickson and M. E. Hogan, Jr. *Phys. Rev.* 49. *pp.* 150–155, *Jan.* 15, 1936.—The analyses of the *B* and *C* band systems of SrD and of a portion of the *D* system of SrH are presented. $B_e{}^* = 1·9427$ for SrD and 3·8788 for SrH for the normal $^2\Sigma$ state. The ratio of these, 0·50635, shows about the expected departure from equality with the ratio $\rho^2 = 0·50603$ of the reduced masses. The spin doubling of this SrD state is regular, $\gamma_0 = +\,0·0613$ being almost exactly in the ratio ρ^2 with the value for SrH. The spin doubling of the $B\ {}^2\Sigma$ state of SrD departs markedly from the usual linear variation with $K + \frac{1}{2}$. Multiple perturbations occur in the (0,0) *C* band of SrD, and there is a sharp cut-off of the branches $K' = 29$. For this $C^2\Sigma$ state $B_0 \cong 1·95$, but exact analysis is hindered by the lack of any unperturbed lines. Two bands (v', 2) and (v', 3), with a common upper state, of the $D\,^2\Sigma \rightarrow N\,^2\Sigma$ "many-lined" SrH system are analysed. In this *D* state, for which $B_v = 1·913$, large irregular perturbations occur. Electronic configurations are discussed.

AUTHORS.

1217. Band System of Caesium. P. Kusch and F. W. Loomis. *Phys. Rev.* 49. *pp.* 217–218, *Feb.* 1, 1936.—A further attempt is made to analyse a band system of Cs_2 at 6250 Å. It has been possible to arrange a number of bands, degraded to the red, into a square array and to assign quantum numbers to the lower state. An assignment reported for this system by Matuyama is shown to be incorrect [see Abstract 5051 (1934)].

AUTHORS.

1218. Band Spectra of Rubidium and of Its Combinations with Other Alkali Metals. P. Kusch. *Phys. Rev.* 49. *pp.* 218–222, *Feb.* 1, 1936.—The magnetic rotation spectrum of Rb_2 is observed and a vibrational analysis made. The vibrational frequency in the $^1\Sigma$ ground state is 57·31 cm.$^{-1}$ and that in the excited $^1\Pi$ state, 48·05 cm.$^{-1}$. The magnetic rotation spectrum of NaRb is also found and has the vibrational frequencies

$106 \cdot 6$ cm.$^{-1}$ and $61 \cdot 5$ cm.$^{-1}$ in the $^1\Sigma$ ground and excited $^1\Pi$ states, respectively. A band system due to RbCs is identified. AUTHOR.

1219. Amount of Light Emitted in the Nitrogen Spectrum Excited by Electron Collisions. O. Herrmann. *Ann. d. Physik*, 25. 2. *pp.* 166–184, *Jan.*, 1936.—The excitation functions of negative bands of N_2 are determined. The absolute amounts of light emission from three negative and five of the second positive group of the N_2^+ and N_2 band spectra respectively are measured, these being the first absolute measurements of their kind of band spectra emission. The absolute emission of the totality of electron transitions in the negative band system is found to be 2 %. The act of exciting does not influence the vibrational energy of the colliding electron since the intensity ratio of the individual bands is independent of the electron velocity. [See Abstract 1195 (1936).] J. E. K.

1220. Partial Calculation of the Potential Functions of the Benzene Molecule on the Hypothesis of Plane Hexagonal Symmetry. C. Manneback. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 237–252, *Dec.* 27, 1935.—Certain terms of the potential functions are evaluated numerically. The results indicate that the influences of anharmonicity and of certain coupling terms are quite considerable. [See Abstract 3888 (1935).] W. R. A.

1221. Spectrum and Force Constants of the Ethylene Molecule. L. G. Bonner. *Am. Chem. Soc., J.* 58. *pp.* 34–39, *Jan.*, 1936.—A complete reinvestigation is made of the Raman spectrum and of the infra-red absorption spectrum of C_2H_4 in the photographic region. Three new Raman lines are found and eleven new infra-red absorption bands. Using these new data it is possible to assign reasonable frequency values to all the twelve fundamental vibration modes of the ethylene molecule. From these frequency values, and the necessary formulæ, eight of the force constants of the molecule are obtained. AUTHOR.

1222. Rotation Constants, B, D and Y, of the $^3\Pi$-Terms of TiO, C_2, CO, PH, AlH, and NH. A. Budó. *Zeits. f. Physik*, 98. 7–8. *pp.* 437–444, 1936.—The rotation constants are calculated and tabulated. W. R. A.

1223. Calculation of the Constants of the Methane Molecule. T. Neugebauer. *Zeits. f. Physik*, 98. 9–10. *pp.* 638–656, 1936.—A method is described for calculating the constants of CH_4. Within the proton tetrahedron C^{4}-, and outside it Ne-, eigenfunctions are used, and the polarisation energy of the protons considered in the inhomogeneous field of the proton. As a result the C–H distance is found to be about $2 \cdot 1$ % too small in relation to the value found by Mecke and the calculated energy likewise is found to be about $12 \cdot 5$ % too low. It is pointed out, however, that all the energy values are not sufficiently known to enable an exact comparison with experiment. The stability of the model is discussed and it is shown that it also remains steady during deformations of the proton tetrahedron. Three eigenfrequencies have likewise been calculated and are in sufficient agreement with experiment. The accuracy of the method is discussed and is found to be responsible for the too small energy values obtained; difficulties of convergence sometimes rendered the calculations impossible. No arbitrary constants were introduced into the calculations. H. H. Ho.

1224. Normal Vibration Frequencies of the Molecule XYZ_3. Jenny E. Rosenthal and H. H. Voge. *J. Chem. Phys.* 4. *pp.* 134–136, *Feb.*, 1936.—A very general expression is set up for the potential energy of the tetrahedral molecule XYZ_3. The normal vibration frequencies are given as functions of the constants in this expression. The equation for the parallel frequencies is essentially independent of the shape of the tetrahedron, but for the perpendicular case the two angles determining the molecular configuration must be taken into account. [See following Abstract.] N. M. B.

1225. Potential Functions of Molecular Groups and the Vibrations of the Halogen Derivatives of Methane. H. H. Voge and Jenny E. Rosenthal. *J. Chem. Phys.* 4. *pp.* 137–143, *Feb.*, 1936.—Assuming the invariance of the molecular groups YZ_3 and YX, formulæ are given connecting the potential energy constants of the molecules YZ_4, XYZ_3, ZYX_3, and ZX_4, and the assumption, tested for the series CH_4, $ClCH_3$, $HCCl_3$ and CCl_4, is shown to be a very good approximation. The application leads to a determination of the general potential functions of all four molecules. Frequencies of $HCCl_3$ and $DCCl_3$ are calculated from those of CH_4, $ClCH_3$, and CCl_4, and are in good agreement with observed data. Predictions are made for the frequencies of $ClCD_3$. A certain ambiguity exists for the constants for the perpendicular frequencies of $HCCl_3$ and $ClCH_3$, since two different chemically acceptable sets will account for the observed frequencies. The CH_4 constants are discussed in detail. [See preceding Abstract.] N. M. B.

1226. Collision Induced Emission. W. M. Preston. *Phys. Rev.* 49. *pp.* 140–144, *Jan.* 15, 1936.—A discharge through Hg vapour at about 0·02 mm. + A or He at about 10 cm. pressure emits a continuum on the short-λ side of the weak "forbidden" Hg line $^3P_2 \rightarrow {}^1S_0$, λ2269·8, rising steeply to a maximum near λ2259 and then falling slowly to 10% near λ2237. The radiation is by metastable Hg($^3P_2$) atoms perturbed by closely approaching A or He atoms, the thermal energy being added to the excitation energy to yield a larger quantum. As the whole continuum is many times stronger than the line, the probability of emission is greatly increased during the close approaches, even though the time of a perturbation is much less than the interval between such approaches. The *j* selection rule, which normally forbids this transition, breaks down in the field of the approaching atom ; this is theoretically reasonable. W. J.

***1227. High Intensity Method for Study of the Stark Effect with Homogeneous Field. W. Steubing and J. A. Schaeder.** *Ann. d. Physik,* 25. 2. *pp.* 97–123, *Jan.*, 1936.—The feature of the method is the use of a hollow kathode and the employment of a glow-lamp stabilising device to ensure constancy of the high voltage "Stark" field with variations of the current between the field electrodes. Glass, quartz and metal discharge tubes are used, and are described in some detail. Sufficiently high gas pressures could be used to enable the Stark effect in molecular spectra to be studied, while the intensity of the field was determinable directly from the p.d. between plane electrodes and their distance apart. Preliminary observations for H_2, He, N_2 and O_2 are reported. W. S. S.

1228. Broadening by Collision of the Rayleigh Scattering of Compressed Gases. E. Kappler and J. Weiler. *Ann. d. Physik,* 25. 3. *pp.* 272–280, *Feb.*, 1936.—Reference is made to Weiler's investigation of the distribution of intensity in the Rayleigh lines of compressed gases [see Abstract 4284 (1935)]. For the course of the curve of intensity obtained from the records of observation no satisfactory explanation has been found. Collision broadening, hindered rotation, quasi-crystalline structure, complex formation, have been suggested as causes. The first author (pp. 272–279) considers that the unshifted scattered radiation especially shows no collision broadening, and concludes that the behaviour as to intensity of the Rayleigh scattering as it is observed in compressed CO_2 cannot be explained by collision broadening alone. In a supplementary paper (pp. 279–280) the author collaborating with J. Weiler, describes further measurements in compressed CO_2. It was arranged that all lines photographed should have the same blackening. It is found that all scattered lines have the same breadth as the directly photographed primary line. For the Q branch also at all pressures the same breadth as in the primary lines is found. Thus, both Q branch and polarised Rayleigh scattering show no collision broadening. J. J. S.

1229. Raman Spectra of Formates and Constitution of Formic Acid. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 2*A. pp.* 615–620, *Dec.*, 1935.—The Raman spectra of the formates of Na, Ca, Cd and Pb are investigated both as solid and as aqueous solutions and the following average frequencies are obtained for the formate ion :—2834, 2732, 1717, 1534, 1347 and 857 $cm.^{-1}$. The presence of the lines at 2834 and 2732 gives direct experimental evidence of the existence of the CH group in formic acid. The solids yield faint lines also at 2976 and 1398. The frequencies are compared with those of formic acid and its esters and acetic acid and acetates. The presence of the line at 1534 seems to be characteristic of the formates. AUTHOR.

1230. Raman Effect of Acetylenes. Part II. G. Glockler and C. E. Morrell. *J. Chem. Phys.* 4. *pp.* 15–22, *Jan.*, 1936.—Eight Ne-Hg discharge tubes arranged concentrically around the Raman tube are used for excitation. The vibration Raman spectra of C_2I_2 in alcohol and acetone, of gaseous and liquid C_2H_2, and of gaseous C_2HD and C_2D_2 are recorded and interpreted on the basis of symmetry considerations. Liquid C_2H_2 differs from gaseous C_2H_2 to a very marked extent, and it is concluded that a serious distortion of the molecules takes place in the liquid state with a consequent complete change in the symmetry of the molecule ; liquid C_2H_2 is non-linear. Some weak satellites are discussed ; they fit a rotation formula. The free energies of C_2HD and C_2D_2 are calculated and the free energy change of the reaction $C_2H_2 + C_2D_2 \rightleftharpoons 2C_2HD$ is evaluated and the equilibrium constant determined for a series of temperatures. [For Part I see Abstract 335 (1935).] W. R. A.

1231. Raman Spectrum of Crystalline Ammonium Chloride. F. T. Holmes. *J. Phys. Chem.* 4. *pp.* 88–90, *Feb.*, 1936.—Crystalline NH_4Cl is studied in its room-temperature and high-temperature forms. Cylindrical crystals are grown by sublimation in a special furnace. At room-temperature vibrational frequencies are observed at 3146, 3041, 2824, 2010, 1768, 1709, 1407 and subsidiary frequencies at 3300, 3232 $cm.^{-1}$ In the high-temperature modification vibrational frequencies are observed at 3102, 2801, 1931, 1655, 1400 cm^{-1}. AUTHOR.

***1232. Low-Voltage Source of Ultra-Violet Continuum. A. E. Smith and R. D. Fowler.** *J.O.S.A.* 26. *pp.* 79–82, *Feb.*, 1936.—A l.v. hydrogen discharge tube giving an intense continuous spectrum in the ultra-violet is described. The variation of the intensity of the continuum with pressure, current and discharge voltage is determined. For a given power consumption 220 V is found to be more efficient in exciting the continuum than 1200 V. The hot kathode makes it possible to maintain discharges at much higher pressures with 1200 V than was possible with a cold kathode. The manner in which the relative intensities of the continuum, secondary, and series spectra of hydrogen vary with pressure and discharge voltage, indicates that they are largely excited by electron impact rather than by recombination. AUTHORS.

***1233. Periodic Emission of Light from H.F. Discharge Tube. A. R. Frey.** *Phys. Rev.* 49. *pp.* 305–308, *Feb.* 15, 1936.—An investigation is made of the light emitted by a discharge tube containing air at low pressure when the tube is driven by a h.f. oscillator. A vacuum photo-cell operated with an alternating h.f. driving potential is used as a receiver. It is found that the light is fluctuating in character even when the driving frequency is as high as $10^7 \sim$, and that the average illumination lags behind the driving potential by an angular amount which for the higher frequencies is a considerable fraction of a cycle. This indicates that the light emitted from the excited atoms persists after excitation for a time which is of the order of magnitude of 5×10^{-8} sec. By using various path lengths between the source and the receiver the apparatus is also used to make a rough determination of the velocity of light. The result obtained agreed with the accepted value within the experimental error of the apparatus, which is approximately 5 %. AUTHOR.

***1234. Application of Punched Card Equipment to the Analysis of Complex Spectra. J. V. Atanasoff and A. E. Brandt.** *J.O.S.A.* 26. *pp.* 83–88, *Feb.*, 1936.—The punched card tabulating and sorting equipment generally used in statistical and accounting work is applied to the analysis of complex spectra into term values. The wave numbers of the lines are punched on the special cards provided for use with the machines. The method enables wave-number differences which frequently occur to be determined or those line pairs showing a given frequency difference to be isolated. The advantages of the method include high speed, accuracy as high as desired without checking with an adding machine, and the fact that only one simple modification is needed of standard equipment that is available almost everywhere. AUTHORS.

See also Abstracts 1049, 1081, 1124, 1262, 1271, 1303.

VISION.

1235. Anatomical, Physiological and Pathological Bases of Stereoscopy. L. Heine. *Naturwiss.* 23. *pp.* 855–860, *Dec.* 20, 1935.—Discusses the distribution of nerve fibres in the optic nerves and in the brain necessary to account for stereoscopic vision. W. S. S.

1236. Accommodation. G. Colange. *Rev. d'Optique*, 14. *pp.* 385–389, *Nov.*, 1935.—The author gives the results of a large number of measurements for different subjects of the degree of accommodation of the eye when an object at infinity is focussed in a telescope (*a*) with a graticule previously adjusted with respect to the ocular by the subject, (*b*) with no graticule. In both cases and for the great majority of the subjects the setting corresponded to a marked accommodation of the eye (statistical frequency curves showing a maximum at about two dioptres) the presence of the graticule having little effect. The adjustment of the graticule with respect to the ocular corresponded to an even greater accommodation so that in general there was parallax between the image and the graticule. Methods for training subjects to avoid accommodation when using optical instruments are described and possible causes of the effect are briefly discussed. W. S. S.

See also Abstracts 1130, 1160.

X-RAYS.

***1237. Focusing of Kathode Rays in an Ionic X-Ray Tube. V. Danilov.** *Techn. Phys., US.S.R.* 2. 5. *pp.* 444–448, 1935. *In English.*—A study of the literature leads to the conclusion that the curvature of the kathode surface does not affect to any considerable extent the concentration of the kathode rays in an ionic X-ray tube. The sharpness of focus is mainly affected by the parts of the tube in the immediate neighbourhood of the kathode. The focusing action of a cylinder coaxial with the kathode is experimentally proved. A device is described, by means of which it possible to displace the cylinder and thus change the sharpness of focus without taking the tube apart or disturbing the vaccum. AUTHOR.

***1238. Kathode Assembly of Gas X-Ray Tubes. M. J. Buerger.** *Rev. Sci. Instruments,* 6. *pp.* 385–386, *Dec.,* 1935.—It is pointed out that the kathodes of demountable X-ray tubes of the gas type need frequent renewal and that with the usual wax seals this is often troublesome. A new construction is accordingly suggested embodying a rubber gasket which is claimed to give a satisfactory vacuum and to facilitate renewal. The system is applicable to Hadding and to Shearer tubes. G. E. B.

***1239. Self-Rectifying Gas X-Ray Tube. R. W. G. Wyckoff and J. B. Lagsdin.** *Rev. Sci. Instruments,* 7. *pp.* 35–36, *Jan.,* 1936.—Describes a self-rectifying tube specially designed for crystal analysis, and capable of giving a high output. The efficiency of the tube is increased by provision for bringing the spectrometer very near to the focal spot, a specially designed slit-system being incorporated with the tube. Working drawings of the essential parts are given. The various vacuum joints are made air-tight by means of lead seals. G. E. B.

***1240. Shielded Filament X-Ray Tube for Pure X-Ray Spectra. E. Dershem.** *Rev. Sci. Instruments,* 7. *pp.* 86–89, *Feb.,* 1936.—An X-ray tube is described in which a shield is interposed between the tungsten filament and the target in such a manner that the latter is almost completely shaded from visible light and sputtered tungsten. The electrons emitted from the hot filament are drawn around the shield by means of an auxiliary potential of approximately 350 V. The tube has the following advantages, particularly for work with soft X-rays which require vacuum spectrographs. (1) Fogging of photographic plates by visible light is almost entirely eliminated. (2) The intensity of characteristic X-radiation remains constant since the target is shielded from evaporated tungsten. (3) The tube current is more nearly constant since it depends mainly on the auxiliary potential rather than the filament heating current. (4) The life of the filament is increased, probably because of protection by the shield from positive ion bombardment. AUTHOR.

1241. Apparent Failure of the Photon Theory of Scattering. R. S. Shankland. *Phys. Rev.* 49. *pp.* 8–13, *Jan.* 1, 1936.—Compton's simple collision theory of the scattering process indicates the simultaneous production of the scattered photon and a recoil electron, but previous experimental tests of this deduction using X-rays have given inconclusive results partly due to the fact that the recoil electrons have insufficient energy. In the present experiments γ-rays from Ra C are used as the primary radiation and suitably designed Geiger-Müller counters are arranged to record the scattered photons and recoil electrons at any desired angles. With the counters set at the angles predicted from the simple collision theory, the counters gave throughout fewer coincidences than expected theoretically and those observed could be accounted for as due to chance. At angles where no regular coincidences should have appeared the number observed was as great as at the theoretical angles. It thus appears that the predictions of the photon theory are not verified by experiment. Wentzel's wave mechanics theory of the scattering process contains approximations which limit its validity to the ordinary X-ray region. Possibly an extension of the theory could explain the present observations. W. S. S.

1242. Double Refraction of X-Rays in Crystals. J. Frenkel. *Phys. Zeits. d. Sowjetunion,* 8. 5. *pp.* 587–588, 1935. *In English.*—The failure to detect double refraction of X-rays in material bodies is explained as a direct corollary of the fact that their wave-length is of the same order of magnitude or smaller than the interatomic distances. A number of other optical effects which are due to the anisotropy of the separate molecules, *e.g.*, Kerr effect cannot be expected to occur for X-rays. C. J. B. C.

1243. Effect of Temperature on Reflection of X-Rays by Crystals. Part II. Anisotropic Crystals. C. Zener. *Phys. Rev.* 49. *pp.* 122–127, *Jan.* 15, 1936.—In anisotropic crystals the temperature factor for the reflection of X-rays is a function of the orientation of the reflection plane. The general case of anisotropic metals is here treated by an extension of a simple method recently discussed [see Abstract 729 (1936)]. The complete solution is found for metals with hexagonal symmetry. The temperature factor is generally written as e^{-M}. The constant M is explicitly calculated for Zn and Cd (hexagonal symmetry). It is found that for these two metals M is 1·80, 1·73, respectively, as large for the reflection plane normal to the principal axis as for reflection planes parallel to the principal axis. AUTHOR.

1244. K Emission Lines of Chromium. S. Tanaka and G. Okuno. *Phys. Math. Soc., Japan, Proc.* 17. *pp.* 540–547, *Dec.*, 1935. *In English.*—The $K\alpha_1$, α_2, β_1 and β' lines of Cr are studied with the pure element and its compounds: Cr_2O_3, $K_2Cr_2O_7$, $(NH_4)_2Cr_2O_7$, $Cr_2(SO_4)_3$ and K_2CrO_4. Kβ' is clearly separated from the Kβ_1 line only in the cases of Cr_2O_3 and $Cr_2(SO_4)_3$. The effect of chemical combination on the wave-length of the $K\beta_1$ line was scarcely detected. On the contrary, however, the $K\beta_1$ line is shifted toward the longer wave-length side and $K\beta'$ is not separated for the remaining three compounds. The relationship between the behaviour of the Kβ' and the displacement of the Kβ_1 line for the compounds of Fe, Mn and Cr is described. AUTHORS.

1245. Excitation Potential of K$\alpha_{3,4}$ Satellite Lines. L. G. Parratt. *Phys. Rev.* 49. *pp.* 132–139, *Jan.* 15, 1936.—With a two-crystal vacuum spectrometer the curve of the intensity of Kα satellite lines *vs.* voltage of the X-ray tube is determined for the K$\alpha_{3,4}$ lines of Ti. For voltages greater than 11 kV the satellite intensity (total area of the K$\alpha_{3,4}$ satellite structure) relative to the intensity of the Ti Kα_1 lines is 2·21 %; the ratio of peak intensities α_4/α_1 is 0·69 %. The measured excitation potential of the Ti K$\alpha_{3,4}$ lines is 5450 ± 100 V, 500 V in excess of the excitation potential of the K$\alpha_{1,2}$ lines. Assuming 0·85 as the screening constant of a missing K electron on an L electron, it is calculated that the voltage required to produce a state of KL_{III} ionisation in the Ti atom is 5455 V. This value is in excellent agreement with the measured excitation potential and the conclusions of the experiments are in support of the Wentzel-Druyvesteyn theory of the origin of the K$\alpha_{3,4}$ satellite lines. AUTHOR.

1246. X-Ray Absorption in Molecular Gases. Part III. H. Petersen. *Zeits. f. Physik,* 98. 9–10. *pp.* 569–575, 1936.—In continuation of previous work, a simplified method for calculating the fine structure in the X-ray absorption bands of molecular gases is described. Comparison with experimental data for $GeCl_4$ shows that the method gives satisfactory results. [For Part II see Abstract 1527 (1933).] C. B. A.

1247. Wave-Length Measurements in the K-Series of Al, S and Cl, and in the L-Series of Zn. J. Shearer. *Phil. Mag.* 21. *pp.* 501–505, *Feb.*, 1936. *Supplement.*—Precision wave-length measurements have been made for a number of lines using a concave mica reflection grating mounted in a vacuum spectrograph [see Abstract 4302 (1935)]. In the case of the S lines the wave-length is calculated by interpolation between reference lines—Ni and $CoK\alpha_1$ and $K\alpha_2$. For the other elements it is necessary to extrapolate. The data used for the wave-lengths of the reference lines and the mica spacing are those given by Siegbahn. C. J. B. C.

***1248. Measurement of Very Soft X-Rays. E. Wilhelmy.** *Phys. Zeits.* 37. *pp.* 103–107, *Feb.* 1, 1936.—A method for measuring very soft X-rays in röntgens is described, in which is utilised a standard free air ionisation chamber of such length that practically the whole of the radiation is absorbed in the chamber. The apparatus is used to calibrate a soft radiation chamber designed by Rajewsky, and this chamber is shown to be independent of wave-length over a region of 0·08 to 0·35 mm. Al half-value layer. For longer wave-lengths still the air ionisation method is at a disadvantage owing to the discontinuity in the absorption of argon at 3·86 Å. To overcome this it is suggested that the absorption coefficient of air be determined indirectly from that of cellophane or other light material, the "reduced absorption coefficient" obtained avoiding the argon discontinuity. J. E. R.

1249. Field Distortion in the Standard Ionisation Chamber. W. H. Love and W. B. Smith-White. *Brit. J. of Radiology,* 9. *pp.* 51–58, *Jan.*, 1936.—In the experimental realisation of the röntgen by means of a free air ionisation chamber, it is necessary to avoid distortion of the electric field in the ion collecting volume. The dependence of field distortion on collector potential in a standard ionisation chamber is investigated mathematically and an evaluation is made of the volume from which ions are drawn by the collector plate in a typical measurement with such a chamber. It is shown that in this case the effective volume differs from that of a uniform field by less than 0·35 %, if the maximum collector potential is one volt and in general, this difference is approximately proportional to the potential acquired by the collector plate, provided that the potential is small. J. E. R.

***1250. Guarded-Field X-Ray Ionisation Chamber. L. S. Taylor and G. Singer.** *Bureau of Standards, J. of Research,* 16. *pp.* 165–169, *Feb.*, 1936.—The number of guard wires in the NBS guarded-field ionisation chamber has been reduced from 12 to 8, and the other attendant alterations necessitated thereby are given. It is shown that strictly uniform potential distribution between guard wires is not essential and that ionisation between guard wires, therefore, produces no spurious effects within the chamber. Coin-gold diaphragms have replaced those used prior to 1931. Coplanarity of electrodes is assured by making them as a single unit. AUTHORS.

See also Abstracts 954, 976, 977, 991, 1381.

HEAT.

CALORIMETRY.

1251. Effect of Dissolved Air on the Specific Heat of Water over the Range 15° to 20° C. E. O. Hercus. *Phys. Soc., Proc.* 48. *pp.* 282–284, *March* 1, 1936.—The effect of dissolved air on the specific heat of water is calculated thermodynamically from the solubility data, for the case when no air is liberated, either completely or in the form of bubbles. It is shown that the specific heat of water saturated with air at 20° C. under normal atmospheric pressure exceeds that of air-free water by 6×10^{-6} cal./gm. [See Abstract 4617 (1935).] AUTHOR.

1252. Specific and Melting Heats of Solid Helium. W. H. Keesom and (Miss) A. P. Keesom. *K. Omnes Lab., Leiden, Comm. No.* 240*b. Physica,* 3. *pp.* 105–117, *Feb.,* 1936.—The specific heats at constant volume of solid He for densities from 0·20 to 0·22 gm./cm.³ and from 1·2 to 3·0° K. are measured. The curves c_v *versus* T increase more rapidly than would follow from Debye's formula. The Θ_D *versus* T-curves appear to be approximately straight lines. In the investigated region Θ_D changes between 37 ($T = 1\cdot 2$, $\rho = 0\cdot 218$) and 25 ($T = 2\cdot 18$, $\rho = 0\cdot 201$). The calorimetric experiments make it possible to observe for a given density the temperature at which solid He begins to melt as well as that at which the melting is finished or liquid He begins to solidify. The following results are mentioned :—

T °K	Density of solid He melting. gm./cm.³	Density of liquid He solidifying. gm./cm.³	T °K	Melting heat cal./gm.
2·2	0·202	$0\cdot 188_5$	2·5	0·835
3·0	0·216	0·203	3·0	1·089
4·0	0·230 (extrap.)	$0\cdot 217_5$	3·5	1·365

A few specific heats of liquid He under pressures up to 135 atm. are measured. AUTHORS.

See also Abstracts 1054, 1264, 1270.

CONDUCTION.

1253. Theory of the Accommodation Coefficient. L. Landau. *Phys. Zeits. d. Sowjetunion,* 8. 5. *pp.* 489–500, 1935. *In German.*—It is shown that the accommodation coefficient can be deduced from classical theory for two cases in which the calculations permit of simplifications being made. At moderate temperatures this indicates a proportionality with $T^{1\cdot 5}$. For H_2 and He at sufficiently low temperatures a T^3 law is obtained. R. W. P.

See also Abstracts 1259, 1316.

CONVECTION.

1254. Coefficient of Heat Diffusion. M. Mori. *I.E.E., Japan. J.* 55. *pp.* 978–981, *Nov.*, 1935. *English Abstract.*—Determinations are made of the heat transfer from surfaces maintained at various excess temperatures, and a relation is deduced connecting the heat transfer per unit temperature excess with the thickness of the conduction layer, or laminar film of fluid. The Schlieren method is among those used to study the latter quantity. R. W. P.

See also Abstract 1259.

DILATATION.

1255. Transformation of Solid NH_4Br at about −39°. A. Smits, J. A. A. Ketelaar and G. J. Muller. *Zeits. f. phys. Chem.* 175. *Abt.A.* 5. *pp.* 359–376, 1936.—The data obtained from an earlier dilatometric study of the transformation of NH_4Cl at about −30° are first discussed by the aid of graphical thermodynamic treatment, following which measurements are described for the transformation of NH_4Br in the vicinity of −40°. Precautions to secure accuracy are considered. It is concluded from the results obtained, that NH_4Br undergoes a heterogeneous transformation. The behaviour of the compound in the hysteresis zone is very carefully studied, since here the heterogeneous transformation cannot occur, and it is found that homogeneous irreversible inner conversions now take place. The latter reactions are shown to happen only in one phase of the two-phase conglomerate, and for rising temperature in that phase with the greatest molecular volume, whereas for falling temperatures the transformations occur in the phase with the smallest molecular volume. The nature of the pseudo-components is fully considered in the final section of the paper. H. H. Ho.

See also Abstracts 960, 988, 995.

MELTING AND BOILING POINTS.

1256. Interpretation of the Eutectoid Diagram $Fe–Fe_3C$. P. Dejean. *J. de Physique et le Radium*, 6. *pp.* 525–536, *Dec.*, 1935.—A publication by Seigle [see Abstract 1337 (1934)] is criticised. The α–γ transformation in pure Fe and the formation of pearlite are considered in detail and discussed critically with reference to the conclusions reached by Seigle. It is suggested that modification of the classical theory of the transformation of Fe is unnecessary. **J. Seigle** replies. H. J. H. S.

***1257. Determination of Melting Points of Organic Substances. F. Francis and F. J. E. Collins.** *Chem. Soc., J. pp.* 137–142, *Jan.*, 1936.—The *setting point* is the only accurate experimental value for the transition temperature from solid to liquid. When a melting point is determined by the capillary-tube method, higher values are invariably obtained. The divergence usually observed between the setting point and the melting point is reduced when the latter is determined in the apparatus described in this communication. The setting point, however, lies nearer to the temperature at which the molten material, allowed to cool very slowly, commences to solidify in the capillary tube. Hence this temperature affords a better value for the true melting point of a substance than the criterion used at present. The apparatus renders it possible to keep the substance under close observation at temperatures near the melting point. Under these conditions, the existence of metastable forms fusing within 1° of each other can be detected, transition temperatures recorded, and a judgment reached on the purity of the specimen.

AUTHORS.

***1258. Equilibrium between Boiling Liquid and Vapour. L. Meyer.** *Zeits. f. phys. Chem.* 175. *Abt.A.* 4. *pp.* 275–283, 1936.—Apparatus is described and illustrated for investigating the equilibrium between a boiling liquid and its vapour. It consists of a measuring vessel of low heat capacity fitted with a platinum resistance thermometer in which a gaseous mixture can be cooled, and the commencement of condensation determined by observing the point at which a change in rate of cooling occurs. The commencement of boiling can be similarly observed by taking a heating curve. For air containing 21% and 57% of O_2 it is found that boiling commences at 78·8°K. and 82·6°K. respectively, whilst condensation commences at 81·8°K. and 86·6°K. for these compositions. In each case there is an uncertainty of ±0·15°. R. W. P.

1259. Solidification between Two Parallel Planes. K. Lachmann. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 345–358, *Dec.*, 1935.—Mathematical theory is applied to the problem of the cooling of a slab of liquid retained between two parallel planes, the latter being at the temperature of the surroundings, but the initial temperature of the liquid being well above that of solidification. Melting curves and the distribution of temperature set up within the slab at various times are determined and shown graphically. Equations are derived which are applicable to either large or small values of the ratio of the latent heat of fusion to the specific heat. As a numerical example the cooling of copper from a temperature of 1330° C. when bounded by planes 5 cm. apart and at 80° C. is considered. R. W. P.

1260. Volatilisation of Lead Oxide from Lead Oxide-Silica Mixtures. E. Preston and W. E. S. Turner. *Soc. Glass Technol., J.* 19. *pp.* 296–311, *Dec.*, 1935.—The mixtures ranged in composition from 53·96 to 99·80% PbO (24 to practically 100 mol.%) and by rapid cooling could be obtained as glasses up to 90·05% PbO. The initial rates of volatilisation in mg./cm.^{2}/hr. ranged from 0·10 to 11·6 at 900°, 0·20 to 80·0 at 1000°, 1·1 to 250 at 1100°, and 2·0 to 254 at 1200°. The high volatility of the last two members of the series precluded any measurements beyond 1100° and the first two members were devitrified at 900°. The temperature–volatility relationships approximated to a vapour pressure law. The relationship between loss by volatilisation and concentration indicated the existence of the silicates, PbO,SiO_2, $2PbO,SiO_2$, $4PbO,SiO_2$, and further relationships involving the progress of volatilisation with time confirmed this view. The combined heats of decomposition and evaporation were, in the order given, − 56,000 − 49,000 and − 30,000 cal./gm.mol. respectively. Density effects in the melts marred the ideal conditions for the volatilisation, but the results obtained were a general confirmation of earlier work on alkali-silica glasses. At 1200° the calculated vapour pressures of PbO ranged from 0·7 to 72 mm. Hg for the first twelve glasses. At 1100° the vapour pressure of pure PbO was calculated to be 70 mm. Hg. AUTHORS.

See also Abstracts 965, 1064, 1065, 1269.

TEMPERATURE, MEASUREMENT OF

See Abstract 1264.

THERMOCHEMISTRY.

1261. Single Bond Energies. Parts I and II. C-C-Bond in Hexaphenylethane. H. E. Bent, G. R. Cuthbertson, M. Dorfman and R. E. Leary (Part I) and H. E. Bent and G. R. Cuthbertson (Part II). *Am. Chem. Soc., J.* 58. *pp.* 165–173, *Jan.*, 1936.—In Part I a general method is described for determining heats of reactions which is particularly suited to the study of easily oxidised substances which must be kept out of contact with the air. This apparatus permits the simultaneous measurement of the amount of gas absorbed or evolved by the reaction. The vapour pressure of *n*-heptene-I is determined from 0·90° and from these data the heat of vaporisation calculated. The heat of hydrogenation of *n*-heptene-I and the heat of oxidation of hexaphenylethane, together with the heats of solution of the compounds involved in these reactions are determined. The dissociation of hexaphenylethane is found to be due about equally to the weakening of the C-C bond in the ethane and to the stabilising effect of the resonance energy of triphenylmethyl. The measurement of the heat of hydrogenation of hexaphenylethane to form triphenylmethyl forms the subject matter of Part II. The values obtained are − 40·5 when the reaction involves solids and − 34·8 when the reaction involves materials in solution in ethyl acetate. The C-C bond in hexaphenylethane is calculated to be weaker than a normal bond by about 30 k.cal. H. H. Ho.

1262. Calculation of Bond Energies. W. Lasareff. *Physica,* 3. *pp.* 61–64, *Feb.*, 1936. *In French.*—Recent investigations [see Abstract 3561 (1935)] on the dissociation energy of CO impose the values $L_0 = 108$ or 124 k.cal. for the energy of the transition $C_{\text{diam.}} \rightarrow C(^3P)_{\text{gas}}$ at 0° K. The average bond energy $\bar{E}_{c-c}$ in aliphatic hydrocarbons C_nH_{2n+2}, calculated by a thermodynamic cycle on the basis of $L_0 = 108$ or 124 k.cal., becomes 51 or 59 k.cal.—if no correction δA is applied representing the energy difference between the electronic state of C atoms in such molecules as C_nH_{2n+2} and the normal ^3P state of isolated C atoms. These values for $\bar{E}_{c-c}$ are appreciably less than those indicated by the available experimental data giving $\bar{E}_{c-c} > 70$ k.cal. Consequently there is strong evidence for the necessity of introducing the correction term δA in the thermodynamic cycle starting from the equation; $C_nH_{2n+2} \rightarrow n \cdot C + (2n + 2)$. H. Gershinowitz's criticism (*J. Phys. Chem.* 39. *p.* 1041, 1935) is rejected. H. H. Ho.

1263. Mass- and Velocity-Distribution Resulting from Explosion of Fragile Balls. S. Suzuki and H. Nagasima. *Phys. Math. Soc., Japan, Proc.* 17. *pp.* 528–539, *Dec.*, 1935. *In English.*—Balls made of sealing-wax are broken by the explosion of bursting powder and the mass-distribution of the broken pieces is investigated. The distribution curve is hyperbolic on the whole with a lump or in rare cases, two, on the tail of the curve. This can be explained by the supposition that the larger pieces distribute themselves in a different way from the smaller pieces. To investigate the velocity-distribution, a number of small lead shot, packed in a hollow spherical rice-cake, are scattered in a large mass of jelly, which is made of agar. The initial velocities of the shot are calculated from the range of the shot in the jelly. The curve of the velocity-distribution thus obtained is that of probability. The close examination of this distribution reveals the fact that the shot are not in such a state of disorder as could be called " molecular chaos." Velocities and paths of the stars in sky-rockets are briefly mentioned. [See Abstract 1314 (1933).] AUTHORS.

1264. Temperature and Latent Energy in Flame Gases. W. T. David. *Phil. Mag.* 21. *pp.* 280–282, *Feb.*, 1936.—As the result of experiments, in which a resistance thermometer composed of fine Pt-Rh wire is used to measure the temperature of inflamed gases during the pre-pressure period in a gaseous explosion, it is inferred that there exists in flame gases a considerable long-lived latent energy [see Abstract 4246 (1934)]. Further experiments are now recorded in which this latent energy varies from 8 to 28 % of the heat of combustion, and is concluded to depend upon (1) the nature of the combustible gas, (2) the nature of the diluent gases, and (3) the pressure at which combustion takes place. R. W. P.

1265. Colloid Chemical Reactions at High Temperatures. S. I. Djatschkovsky. *Kolloid Zeits.* 74. *pp.* 51–57, *Jan.*, 1936.—The behaviour of colloidal solutions in autoclaves at high temperatures is investigated. Lyophobic colloids (gold, platinum, silver) always coagulate. Lyophilic sols lose their electrolytes at high temperatures; also, in view of an increase in kinetic velocity the particles are deformed. Colloidal iron hydroxide desolvates at higher temperatures, undergoing a secondary thermo-solvation by a further rise in temperature. It is indicated that the easy removal of water by drying means desolvation of the particles, which lose adsorbed water from the surface of the micelles. As lyophilic colloidal systems easily alter their system of equilibrium, no irreversible coagulation was noted here. The author was able to follow the change of a positively charged sol, for colloidal iron hydroxide, into a negatively charged sol. V_2O_5 at high temperatures changes into a molecular form, thereby HVO_3 crystallises out. J. K.

***1266. Pressure and Ionisation in Front of the Explosion Wave of the Pre-Detonation Period. A. E. Malinowski, B. I. Naugolnikow and K. T. Tkatschenko.** *Phys. Zeits. d. Sowjetunion,* 8. 5. *pp.* 536–540, 1935. *In German.*—Apparatus for determining simultaneously the flame velocity, propagation of the compression wave and ionisation accompanying propagation of flames is described, and results obtained are illustrated. J. S. G. T.

See also Abstract 1270.

THERMODYNAMICS.

1267. Equation of State of Solutions of Strong Electrolytes and the Virial Law. B. N. Finkelstein. *Acta Physicochimica,* 3. 5. *pp.* 753–755, 1935. *In German.*—Expressions for the "electric" free energy, the energy of solution and the virial law for solutions of strong electrolytes are derived by application of the Gibb-Helmholtz free-energy principle. J. S. G. T.

1268. P.V.T. Relations of Gaseous Mixtures. E. R. Gilliland. *Indust. and Engin. Chem.* 28. *pp.* 212–215, *Feb.*, 1936.—The slope of the isometric of a mixture can be calculated by the molal average of the slopes of the isometrics of the pure constituent gases, all measured at the same molal concentration. This rule, together with a method for estimating the internal pressure, furnishes a means of predicting the P.V.T. properties of the mixture. For the three gaseous mixtures given, the agreement with the experimental data is better than either Amagat's or Dalton's laws, and is probably within the experimental error of the data. AUTHOR.

1269. Heat of Mixing, Entropy, and Equilibrium Curves of Oxygen-Nitrogen Mixtures. V. Fischer. *Zeits. f. ges. Kälte-Ind.* 43. *pp.* 11–15, *Jan.*, 1936.—Quantities are derived which are of importance in calculations relating to air liquefaction and separation apparatus. Use is made of the results of Dana [see Abstract 326 (1926)] for the latent heats of vaporisation of O_2 and N_2, which enable the heat of mixing and change of entropy of liquid O_2–N_2 mixtures to be calculated. These two quantities are plotted, and equations are formulated from which the equilibrium-isotherms and -isobars of O_2–N_2 mixtures can be derived for a pressure of about 1 atmosphere in the surroundings. R. W. P.

1270. Heat Capacity, Entropy and Free Energy Data for the Isomeric Butenes. S. S. Todd and G. S. Parks. *Am. Chem. Soc., J.* 58. *pp.* 134–137, *Jan.*, 1936.—The heat capacities of the four isomeric butenes are measured between liquid air temperatures and their respective boiling points. The entropies of *cis*-butene-2, *trans*-butene-2 and isobutene at 298·1° K. are calculated from these heat capacities in conjunction with other data. An estimate is made for the entropy of butene-1. The free energies of formation of these four butenes are also calculated. The order of increasing thermodynamic stability is apparently: butene-1, *cis*-butene-2, *trans*-butene-2, isobutene. AUTHORS.

1271. Free Energies and Vapour Pressures of the Alkali Metals. A. R. Gordon. *J. Chem. Phys.* 4. *pp.* 100–102, *Feb.*, 1936.—The free energies of the diatomic alkali vapours K_2, Na_2 and Li_2 are calculated from spectroscopic data, and the equilibrium constants for the dissociation into the monatomic form are computed. With the aid of these constants, equations are deduced from the observed vapour pressures obtained by various investigators, which give the partial pressures of atoms and molecules in the saturated vapours for temperatures up to the normal boiling point. In the case of Na and K, the entropy of the solid metal is computed from the vapour pressure equation, and is compared with that predicted by the third law of thermodynamics. AUTHOR.

1272. Thermodynamic Study of Systems of Type $PbCl_2$—RCl—H_2O at 25° C. E. Hunter and A. J. Allmand. *Faraday Soc., Trans.* 32. *pp.* 502–511, *Feb.*, 1936.—The measurement at 25° C. of the aqueous vapour pressures of solutions containing KCl and $PbCl_2$ in equilibrium with various solid phases, as also of certain unsaturated solutions is described. The results are not in agreement with previous calculations made from electrometric work carried out on the same system [see Abstract 3706 (1933)]. An examination of the discrepancies leads to the conclusion that the electrometric data are of insufficient accuracy. Over a narrow concentration region, abnormally high aqueous vapour pressures, approaching that of pure water, were frequently observed. This region is the same one in which discordant analytical and e.m.f. data had previously been obtained. AUTHORS.

See also Abstracts 1026, 1251, 1255, 1274, 1318.

VAPOUR PRESSURE.

1273. Vapour Pressure of Drops. S. W. Gorbatschew. *Kolloid Zeits.* 73. *pp.* 263–267, *Dec.,* 1935.—A molecular-kinetic derivation is given of the dependence of the saturation vapour pressure of drops upon the radius, and it is shown that the Kelvin equation is a first approximation. A simple method, based on their surface tension, is proposed for the calculation of the molecular radius of liquids. A second approximation is also given for the dependence of the saturation vapour pressure of liquids on the radius of curvature of their surfaces. It is shown that the surface activity of a dissolved substance must influence the vapour pressure over a liquid which possesses a surface of visible curvature. An equation is also given for the dependence of the vapour pressure over drops which contain a sparingly soluble substance of active surface, on the radius of the drops, on the concentration of the dissolved substance and on the constants of its surface activity. H. H. Ho.

1274. Continuation of the Vapour Pressure Curve above the Critical Point. F. Krüger. *Phys. Zeits.* 37. *pp.* 56–58, *Jan.* 15, 1936.—Trautz and Ader on the one hand and Eucken on the other, have proposed rules for continuing the vapour pressure curve above the critical point [see Abstract 3121 (1935)]. The former states that only when the critical volume is employed for vapour pressure measurements can a curve be obtained without discontinuity, whereas the latter author shows that analytically the continuation above the critical point may be established by the expressions: $\delta^2 v/\delta p \delta T = 0$, $\delta^2 v/\delta T^2 = 0$, $\delta^2 v/\delta p^2 = 0$ and $\delta^2 H/\delta T \delta p = 0$, where H is the enthalpy. The present author now shows that both sets of conditions give identical results in the immediate vicinity of the critical point when the validity of the van der Waals equation is assumed for the critical region. H. H. Ho.

See also Abstract 1260.

ACOUSTICS.

1275. Behaviour of Sense of Touch towards Vibrations. A. Hugony. *Alta Frequenza,* 4. *pp.* 603–611, *Oct.,* 1935.—Human vibrotactile sensitivity varies with the frequency. Various experimenters have determined the threshold of sensation but their results are not in perfect concordance. The results are here reported of new determinations of threshold of sensation and equivalence is stabilised among some four levels for vibrations of different frequencies. The field explored is from 15–1500 ~, the equivalence among the various vibrations being established, with critical statistics, by comparison with a standard vibration of 200 ~, at amplitudes, respectively to the threshold, of 12·5, 25, 37·5, and 50 db. The "level" curve reveals an interesting similarity to that established by Kingsbury for sound. There is a probability of the existence also of a threshold of pain. [See Abstract 3362 (1934).] J. E. B.

1276. Oscillations of Membranes and Plates. R. C. Colwell. *Acoustical Soc. of America, J.* 7. *pp.* 228–230, *Jan.,* 1936.—The nodal lines of vibrating membranes and plates are obtained and photographed. For frequencies below 500 ~ stretched paper membranes, either round or square and 10 in. across, are used. For higher frequencies, up to 15 kc./sec., thin brass plates are employed and for still higher frequencies (50 kc./sec.) thin glass discs of 1 in. dia. A valve generator is used and up to 10 kc./sec. the oscillations are applied by means of a rod connected to the centre of an electrodynamic loud-speaker. For the higher frequencies a magnetostrictive nickel rod is energised from the valve generator and applied to the plate under test. The Chladni figures thus obtained by the use of fine sand scattered over the diaphragms and plates are seen to be very complex in character, particularly for the high frequencies. It is suggested that this complexity may in part be accounted for on the supposition that the plates may vibrate in segments as well as a whole. A. W.

1277. Standing Sound Waves in the Boehm Flute Measured by the Hot Wire Probe. R. W. Young and D. H. Loughridge. *Acoustical Soc. of America, J.* 7. *pp.* 178–189, *Jan.,* 1936.—The probe consists of 16 mm. of 0·001 in. Pt wire welded to two parallel copper wires so that the filament lies horizontal and perpendicular to the axis of the flute. The flute is blown mechanically. The hot wire forms one arm of a Wheatstone bridge by means of which the constant resistance change at a point is measured, and an amplifier is employed to observe the periodic changes in resistance. Graphs are given of these two resistance changes for positions of the filament along the flute for given notes sounded. The graphs are discussed fully, and it is concluded that although it is impossible to insert into a vibrating air column a probe that will measure the condition existing previous to the insertion, considerable knowledge may be gained of the standing wave system formed within the instrument. The standing wave had a noticeable amplitude extending beyond about three open tone holes, and the effect of omitting these resonance holes is shown. G. E. A.

1278. Problem of "Touch" in the Pianoforte. A. Ferrari. *Alta Frequenza,* 4. *pp.* 582–602, *Oct.,* 1935.—The problem of "touch" in the pianoforte is here studied experimentally for sounds of equal intensity and different timbre. Numerous oscillograms are analysed, obtained as a result of measuring piezoelectrically by quartz crystal the pressure exerted by the hammer. The mechanical arrangements and oscillograms are reproduced and curves fully show the findings of the inquiry. J. E. B.

1279. Tuning of Pianos. M. Grützmacher and W. Lottermoser. *Phys. Zeits.* 36. *pp.* 903–912, *Dec.* 15, 1935.—To test whether piano tuners tuned according to the equal tempered scale, or made conscious deviations from that, two grand pianos of the same make were tuned in turn by three tuners, and tested after each tuning. The test was carried out by sounding in an earpiece a comparison tone the frequency of which could be adjusted to 0·5 ∼ by means of a frequency meter. The greatest accuracy was obtained from the meter over the range C' to C''' (264 to 1056 ∼), and the semitone intervals over the two octaves were tested and graphed, showing irregular deviations from the tempered scale. These deviations did not affect the ear as errors in tuning but rather as an enrichment of the tone. By using the meter, more consistent tuning was attained, but whether such tuning is ideal the authors do not venture to decide. The experiments show, however, that considerable deviations from the mathematically tempered scale must have occurred for the last 200 years without having been found unmusical. A new system of tuning is suggested which is based on a circle of fifths, in which the fifths are gradually diminished from a perfect fifth in key C major to one which is slightly less than a tempered fifth in F# major. The mean tone tuning of Silbermann was calculated and produced, and its advantages and disadvantages pointed out. G. E. A.

1280. Velocity of Sound in Ethylene Dichloride Vapour. W. H. Billhartz, Jr., and F. L. Bishop, Jr. *Acoustical Soc. of America, J.* 7. *pp.* 225–227, *Jan.*, 1936.—The velocity of sound in ethylene dichloride vapour at the boiling point is determined by the use of a resonance tube. The frequency of the sound is measured by comparison with the frequency of a wire of known length under known tension. Resonance is indicated by minimum reactance of the acoustical impedance of the tube of gas, on the source of sound as the length of the tube is changed by moving a piston. The precision of the apparatus is verified by preliminary measurements with air at 23·5° C. and steam at 98·5° C. The values found agree to within 0·5 % of the results of previous observers. For ethylene dichloride, said to be 99·5 % pure and so checked by means of its boiling point, the velocity of sound is found to be 176·2 m. per sec. at 83·7° C. AUTHORS.

***1281. Sound Dispersion and Stereochemistry of the Nitrogen Atom. O. Steil.** *Zeits. f. phys. Chem.* 31. *Abt.B.*5. *pp.* 343–360, 1936.—An apparatus is described by which measurements of the frequency, pressure, and temperature dependence of the velocity of sound can be carried out at inaudible frequencies between room-temperature and 150° C. An anomalous dispersion of the velocity was established for NH_3 between 300 kc. and 1000 kc. More exact investigation of the frequency and pressure dependence of the velocity of sound in this region gave the result that the anomaly is connected with the stereochemistry of the nitrogen atom. The author discusses at some length an extension of this work which will confirm or invalidate his tentative conclusions. H. H. Ho.

1282. Anomalies in Acoustic Wave Propagation of Large Amplitude. E. F. Ghiron. *Alta Frequenza*, 4. *pp.* 530–581, *Oct.*, 1935.

—This paper considers, from initial conditions, the propagation of plane acoustic waves without assuming the ordinary hypothesis that the amplitude of the wave is negligible compared with the length. It shows how the velocity of propagation, until interrupted by discontinuities, remains always that given by the ordinary theory. The existence is stressed of a functional relationship between the velocity and the dilatation in a layer of the medium in which the wave is propagated. It is deduced that a sinusoidal wave is necessarily deformed during propagation, the deformation continuing to grow until a point is reached where the wave becomes discontinuous. This has an analogy in submarine waves of great depth. By calculating the form assumed by a sinusoidal sound wave as distance from source increases, a measure of the distortion introduced as propagation continues is obtained, and, probably in a quite new form, an expression is obtained for the pressure of acoustic radiation in a system of plane progressive waves of similar form. [See Abstract 824 (1935).]
J. E. B.

1283. Sound Absorption in Liquids at Supersonic Frequencies. H. Oyama. *I.E.E., Japan, J.* 55. *pp.* 985–989, *Nov.*, 1935. *English Abstract.*—The liquids tested were KCl and NaCl solutions and distilled water. The liquid under test was contained in a Dewar test tube and the temperature rise on passing supersonic sounds through the liquid was measured with a thermocouple. The temperature rises in the different liquids were found to correspond with the damping coefficients calculated for the liquids. The results obtained with liquids of different viscosities tend to show that the temperature rise does not depend on viscosity, but is a characteristic of each liquid. All the liquids tested showed either a maximum or minimum temperature rise at some particular frequency. Distilled water showed maximum heat development at 700–800 kc./sec. The method used could be employed to measure the damping of supersonic waves in the oil-bath of the apparatus and the damping thus measured was of the same order as the radiation damping resulting from supersonic sound diffraction.
A. W.

1284. Propagation of Supersonic Vibrations in Liquids. R. Lucas. *Comptes Rendus,* 201. *pp.* 1172–1174, *Dec.* 9, 1935.—To explain the fact that the coefficient of enfeeblement of supersonic waves as determined experimentally is often much greater than that calculated, it is suggested that this may be due to diffusion of the waves, in much the same way as a beam of light is weakened by passing through a turbid liquid. Possible causes of such " sonic turbidity " are fluctuations in density, and the tendency of molecules of a liquid to unite in more or less symmetrical groups.
C. A. S.

1285. Temperature Variation of Absorption of Supersonic Waves by Liquids. E. Baumgardt. *Comptes Rendus,* 202. *pp.* 203–204, *Jan.* 20, 1936.—The experimental results obtained by Biquard, Quirk and Bažulin have shown that the measured coefficients of absorption of supersonic waves for liquids are much higher than would be expected theoretically. It is easy to show that in the theoretical formula for the coefficient of absorption the term representing the damping due to viscosity is much the most important. This term is $\alpha_s = 2\eta\omega^2/3\rho_0 V_0^3$, where η is the coefficient of viscosity, ρ_0 the density, ω the circular frequency and V_0 the velocity of sound. For many liquids the variation with temperature of ρ_0, V_0 and η is known, so that for a fixed frequency but a variable temperature one should have $a_a(t) = \text{const.}\,\eta(t)/\rho_0(t)[V_0(t)]^3$. Measurements of the variation with temperature of the absorption of supersonic waves by water were made for the temperature range 18° to 40° C., using a frequency of $7 \cdot 96 \times 10^6$. The method of measurement was that used by Biquard, with slight modifications. The results obtained are in good agreement with a law of variation of the coefficient of absorption of the type $a_a = \text{const.}\,\eta/\rho_0 V_0^3$. A. W.

1286. Multiple Wall as Acoustico-Mechanical Filter. E. Meyer. *E.N.T.* 12. *pp.* 393–400, *Dec.*, 1935.—A multiple wall, that is, one built up of a series of single walls with air cushions between, is, from the point of view of sound technique, a mechanico-acoustical filter. It possesses a marked limiting frequency given by the wall dimensions and the thickness of air cushions; the transmission velocity rises with rising pitch. These conclusions from filter theory admit of ready verification in the case of multiple walls. On the other hand the rise of damping is importantly slighter after the limiting frequency than in the corresponding electrical case. A multiple wall, constructed in accordance with the results drawn from the investigation, of density 50 kg./m.² had a sound insulation of 55 db, that is, it corresponded to a massive brick wall about 50 cm. thick and 1000 kg./m.² J. E. B.

1287. Transmission of Plane Waves through Multiple Partitions. A. L. Kimball. *Acoustical Soc. of America, J.* 7. *pp.* 222–224, *Jan.*, 1936.—The author calculates the sound reduction to be expected from an idealised double partition and obtains results which agree with those obtained by Constable [see Abstract 3834 (1934)]. Calculation is also made of the improvement in sound insulating power to be expected from hanging a flexible layer of an impervious material against an already existing partition. It appears that considerable improvement in the sound insulating qualities should be obtainable but the author points out that there will probably be practical difficulties. J. E. R. C.

1288. Acoustical Work of the National Physical Laboratory. G. W. C. Kaye. *Acoustical Soc. of America, J.* 7. *pp.* 167–177, *Jan.*, 1936.—An account is given of the acoustical laboratory recently erected at the National Physical Laboratory together with a description of the work carried out there. J. E. R. C.

1289. Vibrations of the Vocal Ligaments. W. Trendelenburg and H. Wullstein. *Preuss. Akad. Wiss. Berlin, Ber.* 21. *pp.* 399–426, 1935.—The vocal ligaments of larynges excised from calves and men are set in vibration by air currents and their modes of vibration are compared with those of the air which transmits the waves. The methods employed are: for the air vibrations, the Riegger condenser microphone, for those of the vocal ligaments use is made of the Barkhaus condenser microphone, and a shadow method is used in recording changes in the width of the glottis. The motion of the vocal ligaments almost conforms to a sine curve. As regards the fundamental, it corresponds with the air vibrations which however contain strong, high-pitched partials. This fundamental of the ligaments is uninfluenced by resonating cavities added to imitate the mouth cavity. The glottis curve agrees in essentials with the vibration curve of a bowed string. The maximum amplitudes of the partials in air occur during the opening of the glottis. A second maximum is present in the case of the calf. Further, the upper part of the laryngeal cavity acts to strengthen the fundamental of the air vibrations. The paper is well illustrated with photographic records of wave-forms and shadows of the aperture of the glottis. G. E. A.

1290. Time Response of the Ear. W. Bürck, P. Kotowski and H. Lichte, *E.N.T.* 12. *pp.* 355–362, *Nov.*, 1935.—Following Strecker the authors study the time delays which occur in the ear before certain phenomena are observed. This has importance in the impulse excitation of undamped resonant circuits and in phase distortion in long lines. For free-air tests, two frequencies are switched to two loud-speakers, the requisite delay being determined by the relative distances of the two sources of sound from the ear. The distinguishing time differences are given for variable frequencies relative to a number of fixed frequencies. Similar curves were obtained for dead and live rooms, using speech and music as one source. L. E. C. H.

1291. Automatic Gain Control. H. Bartels and G. Ulbricht. *E.N.T.* 12. *pp.* 368–379, *Nov.*, 1935.—The authors study the requirements in compressors and expanders for various applications. The types discussed have metal rectifiers for the non-linear regulating device. The time-constants of operation and restoration are discussed, together with the desirable alteration in frequency-response curves due to non-linear loudness contours of the ear. L. E. C. H.

1292. Directional Properties of Airscrew Sound. J. Obata, Y. Yosida and U. Yosida. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 354–355, *Nov.*, 1935. *In English.*—Model air-screws are rotated by an electric motor on an isolated concrete stand, and the pressure variations are determined at distances of 5 cm. up to several m. from the blade. The configuration of the air near the screw is also determined. Three two-bladed and two four-bladed screws are tested. The strongest tone of the screw is not always the fundamental, also the directional property differs somewhat with the shape and number of the blades. Polar diagrams of the sound distribution are given for different rates of revolution. The results are compared with those of other observers [see Abstract 3359 (1932) and following Abstract.] G. E. A.

1293. Origin of Sound Emitted by Airscrews. Part II. J. Obata, Y. Yosida and U. Yosida. *Tôkyô Univ. Aeronaut. Research Inst. Report, No.* 132. *pp.* 419–440, *Dec.*, 1935. *In English.*—A continuation of previous work [see Abstract 1252 (1934) and preceding Abstract.] The paper is profusely illustrated with diagrams and with photographs of the pressure variations near the screws. G. E. A.

***1294. Indicator with Logarithmic Response. M. Lambrey.** *Comptes Rendus*, 201. *pp.* 1023–1025, *Nov.* 25, 1935.—Since the decibel scale first used in communication engineering has now been adopted for acoustical, photometric and many other measurements a device which which would give a logarithmic response for a linear input is of considerable interest. The author describes a valve circuit using two Philips E.452.T. valves as triodes coupled with resistances and batteries which will give a logarithmic response over a range of about 40 db. Brief reference is made to the systems developed by other workers, in particular Hunt [see Abstract 310 (1934)] who has developed a multi-valve circuit giving a range of 80 db. F. S. B.

See also Abstract 1140.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts 1306, 1313, 1329.

CONDUCTION AND DISCHARGE IN GASES.

1295. Liquid Surface Rupture by Uniform Electric Field. J. Frenkel. *Phys. Zeits. d. Sowjetunion*, 8. 6. *pp.* 675–679, 1935. *In English.*—In a recent paper [see Abstract 4341 (1935)] Tonks proposed an explanation of the fact that with a liquid kathode the sparking potential is about 20 times smaller than with solid ones. Although the correctness of the results is accepted, the method of derivation is unsatisfactory. In the present paper, Tonks' results are derived in an improved form by a mathematically rigorous method, based on the examination of the velocity of surface waves in the presence of the electric field. These waves must exist on the surface of any liquid, representing the superficial manifestation of heat motion. J. E. R.

1296. Duration Time of Light Flashes due to Condenser Discharge. M. Laporte. *Comptes Rendus*, 201. *pp.* 1108–1110, *Dec.* 2, 1935.—An 8 mfd. condenser charged to 1600 V is discharged through an argon-mercury vapour burner across a suitable gap and the duration of the flash of light produced in the burner tube is measured by the rotating mirror method. The flash is found to consist of an initial intense portion of the order of duration of 10^{-5} sec., followed by a less intense portion sometimes of oscillatory structure lasting for about 10^{-4} sec. F. S. B.

1297. Corona Rotation Effect. A. Güntherschulze and H. J. Hesse. *Zeits. f. Physik*, 98. 7–8. *pp.* 476–489, 1936.—Further observations and calculations are given regarding the corona rotation effect described in a previous paper [see Abstract 4646 (1935)]. The profile of the curve traced by the rotating wire is approximately a catenary. J. J. S.

1298. Calculation of Townsend's Ionisation Coefficient α for Neon. M. J. Druyvesteyn. *Physica*, 3. *pp.* 65–74, *Feb.*, 1936. *In English.*—The stationary velocity distribution of electrons, diffusing through a noble gas in a homogeneous electric field is solved for the case of elastic, exciting as well as ionising collisions of the electrons and the gas atoms; the excitation- and ionisation-probabilities are supposed to be linear functions of the electron energy. If the velocity distribution for the electrons is known, many physical properties can be calculated. For Ne the ionisation coefficient α of Townsend is calculated numerically for values of E/p between 5 and 30 V per cm. per mm. gas pressure and is found in good agreement with the experimental values. The energy losses, due to elastic collisions, may be neglected in this case. AUTHOR.

1299. Conditions for Inelastic Impact by Slow K^+ Ions. O. Schmidt. *Zeits. f. Elektrochem.*, 42. *pp.* 8–21, *Jan.*, 1936.—The investigation of collisions of K^+-ions of 200 (and 25) volts with the following gases and vapours: (1) Hg, X, Kr, A, Ne; O_2, N_2; CH_3Cl, CO_2; (2) C_4H_{10}, C_2H_6, CH_4; C_4H_8, C_2H_4; C_4H_6; C_2H_2; CO; NH_3; He; H_2; show that the impacts of the first class are elastic and in the second class more or less inelastic. This phenomenon goes hand in hand with the degree of repulsion exponent *n* which characterises the gas. All gases with large *n* behave purely elastically and have a purely symmetrical distribution curve, whereas the curves for the easily compressible gases are very unsymmetrical. The dipole character has no appreciable influence on the impact result. The great difference in the behaviour of the homologous series in the two classes, by which the energy loss changes with decreasing weight, is connected with the differences in the number of degrees of freedom. The paper is divided into three main sections dealing with: (1) Inelastic collision and chemical reaction; (2) Conditions for inelastic impact; and (3) Determination of the character of the impact from the mass-spectrograph distribution curves. A very complete Bibliography is included. [See following Abstract.] H. H. Ho.

1300. Collison of K^+ Ions with Gas Particles of Inorganic and Organic Nature. O. Schmidt. *Ann. d. Physik,* 25. 1. *pp.* 92–96, *Jan.,* 1936.—In a previous paper [see Abstract 427 (1935)] it has been shown that it is possible to determine if the collision of slow K^+ ions with gas particles at a low pressure is elastic or inelastic by a consideration of the mass spectrograph distribution curves. It appears that the area of such curves for identical maximum intensity for a large number of gases which are members of a homologous series is proportional to pressure and, under certain conditions, to the effective diameter. A proportionality factor is defined (area/effective diameter) and it is shown that gases may be divided into 2 classes; the rare gases show an increase in the factor and in the energy loss per collision with decreasing atomic weight whilst gases like the paraffins show a decrease with decreasing atomic weight. [See preceding Abstract.] H. J. H. S.

1301. Retardation of Hydrogen Canal Rays in Metals. H. Bätzner. *Ann. d. Physik,* 25. 3. *pp.* 233–262, *Feb.,* 1936.—Previous investigations of the passage of H canal rays through metals are discussed. The apparatus described consists of a discharge tube connected to a magnetic analysis system, provision being made for the insertion of metal foils in the path of the beam. The experiments covered an energy range from 4–60 ekV, and the foils used were Al, Cu, Ag, Sn and Au. From the results obtained, the relationships between velocity and energy loss, atomic stopping power and range are derived. It is shown that the relationship between stopping power and atomic number there are differences between the energy range investigated and the region of natural H-particles. J. E. R.

1302. Direct Introduction of Deuterium into Benzene by H.F. Current. J. Horiuti and T. Koyano. *Chem. Soc. Japan, Bull.* 10. *p.* 601, *Dec.,* 1935. *In English.*—D is made to replace H in benzene to the extent of about 0·7 % by the action of a h.f. current, derived from a Tesla coil, in the presence of platinum black. J. S. G. T.

***1303. Arc Between Glass Electrodes. M. Pierucci and L. Barbanti-Silva.** *N. Cimento,* 12. *pp.* 533–540, *Nov.,* 1935.—By covering the ends of carbon rods with glass caps and striking an arc between the rods, the glass is heated and ultimately the arc strikes between the glass. On spectroscopic examination the arc shows many peculiarities notable among which is the striking resemblance to solar protuberances. F. C. C.

***1304. Directionally Selective Ion-Counter. L. M. Langer and R. T. Cox.** *Rev. Sci. Instruments,* 7. *pp.* 31–33, *Jan.,* 1936.—A counter is designed in which the electrodes are a pair of parallel tungsten wires, about

6 cm. long, 0·2 cm. apart, the negative electrode being about 20 mils dia. and the positive electrode 5 mils dia., respectively. The counter discharge, after amplification by a resistance-capacity coupled amplifier is detected by an oscillograph. The directional selectivity is clearly indicated by the deflection falling to about half its value when incident α-particles are inclined as little as 9° to the direction parallel to the wires. The effect was almost independent of the dia. of the wires, the voltage or the gas pressure, so long as the conditions for proportional rather than cascade discharge, were maintained. F. C. C.

***1305. Magnetic Resonance Accelerator. M. S. Livingston.** *Rev. Sci. Instruments*, 7. *pp.* 55–68, *Jan.*, 1936.—Detailed account of the principles, construction and mode of operation of a "cyclotron" or magnetic resonance accelerator. The radius of the ion chamber is 16 cm., while that of the pole-pieces is 16 in. For protons, the magnetic field used is 13,000 gauss with a gap of 3 in., resonance occurring under an alternating electric field of wave-length 15 m. With deutons, the field is 14,800 gauss, the gap 2 in. and resonance occurs at a wave-length of 26 m. Ions of energies 2 MV and 1·35 MV are produced in the two cases respectively. Targets may be bombarded at atmospheric pressure and the cyclotron is equipped with auxiliary devices (ionisation chamber, expansion chamber) for determining the nature of the radiations emitted. F. C. C.

***1306. Simple Method of Producing High A.C. Voltages. W. Hasselbeck and H. Dänzer.** *Ann. d. Physik*, 25. 1. *pp.* 74–76, *Jan.*, 1936.—A circuit and theory are given of a method of producing high a.c. voltages of the order of 5×10^5 V and a resonance current of some 30 mA. The method is specially intended for experimental work in atomic physics. R. L.

1307. Electrical Precipitation of Bacteria in Suspension in a Gas. M. Pauthenier and H. Volkringer. *Comptes Rendus*, 202. *pp.* 250–252, *Jan.* 20, 1936.—Air containing a suspension of bacilli is passed through a metal tube which has a fine wire fixed axially. The bacilli after passing through the tube are incubated. It is found that an electric field of 3000 V/cm. completely prevents the passage of the bacilli through the tube and they can be shown by incubation, to have collected on the central electrode. To avoid the possible effects of ozone, the experiments were repeated in nitrogen, with identical results. J. E. R.

See also Abstract 1245.

CONDUCTION IN SOLIDS AND LIQUIDS.

1308. Hume-Rothery Conception of the Metallic State. C. D. Niven. *Phil. Mag.* 21. *pp.* 291–299, *Feb.*, 1936.—Hume-Rothery has suggested that in metals one electron is shared by more than two atoms. His observation that B group metals incline to crystallise with (8-N) near neighbours, where N is the number of the group, would represent the facts more clearly if it were stated for groups III B to VII B as: in crystallising each atom has (6-N) near neighbours, where N is the number of electrons in the "*p*" system. Bismuth is recognised as holding a unique position in that it has three electrons to share with three near neighbours. This is discussed and thought to explain some of the exceptional qualities of this element. Sharing of electrons between atoms in the way suggested offers a new conception of electrical conduction, for while the electrons are free to move from atom to atom they must remain intimately related to the atomic cores and to each other. Thermal agitation increases the resistance as would the introduction of a foreign atom. The latter would also affect the hardness of the metal. It is suggested that supraconductivity occurs when there is synchronisation of the electronic orbits. R. W. P.

***1309. Automatic Potentiometer of High Speed. R. W. Gilbert.** *Rev. Sci. Instruments,* 7. *pp.* 41–44, *Jan.,* 1936.—The potentiometer is of the form of a fixed resistor carrying a variable current, the magnitude of which is a measure of the terminal p.d., which at balance is equal to the p.d. to be measured. The detector consists of a sensitive moving-coil galvanometer, the beam of light from which is divided, by a prism, into two components, each of which illuminates a photoelectric cell. The deflection causes a differential change of illumination of the two cells, which act in opposition upon a thermionic amplifier, the output of which supplies the current to the potentiometer. Thus, any deflection of the galvanometer causes a change of current in such a direction as to annul the deflection, so that the system remains permanently balanced, and a record of the current in the potentiometer provides a record of the applied voltage. The action of the whole system except the galvanometer is practically instantaneous, so that very high speeds are obtainable. The device may be arranged to record currents as well as voltages. L. H.

***1310. Thermionic Amplifiers for D.C. F. Müller and W. Dürichen.** *Zeits. f. Elektrochem.* 42. *pp.* 31–43, *Jan.,* 1936.—A general review, with full Bibliography, of the methods of measurement of very small direct currents and voltages by means of thermionic valves. The various types of valve available are discussed, and also the various devices which have been employed for the elimination of disturbances due to battery fluctuations, etc. L. H.

***1311. Magnetic Contamination of Galvanometer Coils. A. Christy.** *Rev. Sci. Instruments,* 7. *pp.* 93–96, *Feb.,* 1936.—An investigation is made of the dependence of the sensitivity of a d'Arsonal galvanometer (suspension type) upon the magnetic contamination of the galvanometer coil. Graphs are drawn showing the effect upon the sensitivity of coils contaminated to various degrees. Examples are given of internal contamination, *i.e.,* contamination of the wire from which the coils were wound, and external contamination, *i.e.,* contamination of the surface of the finished coils. A method is given for removing external contamination. AUTHOR.

1312. Potential Fluctuations in High-Resistance Metallic Conductor. J. Bernamont. *Comptes Rendus,* 201. *pp.* 1106–1108, *Dec.* 2, 1935.—A metallic conductor of small volume and high resistance when carrying a current exhibits potential fluctuations between its ends whose magnitude depends on the value of the current. By means of a selective amplifier the author studies the r.m.s. value of this fluctuating potential in bands of 100 ∼ over the frequency range 96 to 162,000 ∼. Typical curves of results are given for long narrow films of tungsten and kathodically deposited platinum of resistances varying from about 500,000 ohms to 31,000 ohms respectively. The results are briefly discussed and an indication is given that further work is in progress. F. S. B.

***1313. Absolute Determination of the Ohm. H. L. Curtis, C. Moon and C. Matilda Sparks.** *Bureau of Standards, J. of Research,* 16. *pp.* 1–82, *Jan.,* 1936.—The value of the absolute ohm is determined from the mean solar second and the absolute henry. The mean solar second depends on the time signals of the U.S. Naval Observatory, and the absolute henry depends on the computed self-inductance of helices wound on non-magnetic forms. The time signals are used to calibrate a piezoelectric oscillator which controls a 100 ~ generator. The self-inductance is computed for three inductors which have different dimensions and are wound on forms of different materials, namely, porcelain, pyrex glass and fused quartz. The electrical measurements call for an intermediary capacitance, so that a resistance is first measured in terms of inductance and capacitance by an a.c. bridge, then the capacitance is measured in terms of resistance and time by the charge and discharge method of a Maxwell bridge. Assuming that the capacitance is the same under the two conditions stated, it is eliminated between the two bridge equations. The result of this investigation is: 1 NBS international ohm = 1·000450 absolute ohms. The authors estimate that this result differs from the true value by less than 20 parts in a million. The greatest uncertainty arises from irregularities in the pitch of the winding. AUTHORS.

***1314. Electrical-Resistance Alloys of Cu, Mn and Al. J. L. Thomas.** *Bureau of Standards, J. of Research*, 16. *pp.* 149–159, *Feb.*, 1936.—An investigation of the electrical properties of alloys containing from 4 to 15 % of Mn, and from 0 to 10 % of Al, the remainder being Cu. An alloy containing 85 % of Cu, 9·5 % of Mn, and 5·5 % of Al has properties very similar to those of manganin. Its thermoelectric power against Cu is much smaller than that of manganin and this thermoelectric power may be brought to zero by the addition of a very small amount of Fe. Resistance coils constructed from these alloys, with or without added Fe, have been very stable in resistance. By properly baking, their temperature coefficients of resistance at 25° C. may be made as nearly zero as is desired, and this coefficient changes less with temperature than does that of manganin. AUTHOR.

1315. Tension Coefficients of Resistance of the Hexagonal Crystals Zinc and Cadmium. Mildred Allen. *Phys. Rev.* 49. *pp.* 248–253, *Feb.* 1, 1936.—The tension coefficients of resistance of the hexagonal crystals, Zn and Cd, are measured. These coefficients are found to be independent of the secondary orientation. This is in agreement with a theory set forth by P. W. Bridgman [see Abstract 1599 (1933)] as corrected by J. W. Cookson (*Phys. Rev.* 47. *p.* 194, *Jan.*, 1935); furthermore the experimental points lie within experimental error of the curves given by the theory representing them as functions of the primary orientation. Cookson's correction gives the same formal dependence of the coefficients on the orientation as Bridgman's original theory, but demands additional constants fully to define the effect of deforming forces on the electrical resistance. Further experimental work will be necessary completely to determine this entire set of constants, and theory is sketched to show that torsion experiments would furnish the necessary data. AUTHOR.

***1316. Copper-Oxide Rectifier. C. Starr.** *Physics*, 7. *pp.* 15–19, *Jan.*, 1936.—The equilibrium diagram of the copper: copper oxide: oxygen system controls the conditions of formation of the cuprous-oxide rectifier. The interface between the cuprous oxide and the copper from which it is formed can be studied with polarised light. Intimate contact exists for more than half the total area. The technique of preparing the rectifier has a marked influence on its characteristics. By using a method of measuring the resistance characteristic which does not cause an error due to current heating at the interface, unusual results are obtained from specimens made under various conditions. Measurement of the thermal conductance of the rectifier discloses a new physical phenomenon, asymmetrical thermal conductance. This asymmetry is in the direction that would be expected from the electron theory of heat conduction. AUTHOR.

1317. Electrical Conductivity of Glass. Part III. H. R. Kiehl. *Physics*, 7. *pp.* 20–25, *Jan.*, 1936.—Some effects upon current-voltage and temperature relationships as caused by the formation of " impregnated " layers in the vicinity of the electrodes are described. For " unimpregnated " samples, Ohm's law appears to be valid. Upon " impregnation " various current-voltage relationships from $I = AV^n$ to that of Poole are observed, the nature of the function apparently depending upon the characteristics of the layers produced. The Rasch and Hinrichson equation is found valid for fresh samples over the range of temperatures used, but the presence of these layers causes distinct changes in the characteristics of this relationship. The possible importance of such layers upon the electrical properties of glass and other insulating materials at the higher fields and temperatures and their possible effect in causing some of the apparent discrepancies in existing data is pointed out. The importance of much further detailed study of their properties is suggested. [See Abstract 446 (1935).] AUTHOR.

See also Abstracts 988, 1052, 1062, 1294, 1322, 1333, 1355, 1378.

DIELECTRICS AND CAPACITANCE.

1318. Molecular Theory of the Dielectric Constant of Non-Polar Liquids. J. Yvon. *Compes Rendus*, 202. *pp.* 35–37, *Jan.* 6, 1936.—In this mathematical paper, a liquid containing N identical polarisable molecules is subjected to an external electrical field E (M) and for simplification it is assumed that the polarisability α of the molecules is invariable [see also Abstract 768 (1936) for notations]. The following formula is derived :

$$4\Pi\alpha\nu^2/\epsilon - 1 = \nu - 4/3\Pi\alpha\nu^2 - 8\Pi\alpha^2 \int \nu_{12} r_{12}^{-4}\, dr_{12} - \alpha^2 \iint (\nu_{123} - \nu_{12}\nu_{23}\nu)\, r_{12}^{-3} r_{23}^{-3} \\ (3\cos^2\theta - 1)\, dw_2\, dw_3 - \cdots .$$

This result applies also to the case of luminous frequencies if the liquid is transparent, and the classical formula of Lorenz-Lorentz is given if the terms in α^2 are neglected. The term ν_{123} is actually not easy to obtain, but the first term in α^2 is negative whereas the second is positive and of the same dimensions. Numerical data for liquids require a positive correction term. The method now employed should be of value for investigations relating to the diffusion of light. [See Abstract 1026 (1936).] H. H. Ho.

1319. Rotation of Dipoles in Elastic and Viscous Media. N. L. Yates-Fish. *Phil. Mag.* 21. *pp.* 226–233, *Feb.*, 1936.—Debye's dipole theory has been extended to amorphous solids by Gemant [see Abstract 2230 (1935)]. He assumes that any deformation in the medium is opposed by an elastic restoring force decaying exponentially with time, and that the molecule can be regarded as a rigid sphere. It is necessary to know the value of the couple acting on a rigid sphere when rotated in an elastic medium, and the author shows that this value can be deduced from Stokes' formula for the analogous case of rotation in a viscous liquid. E. R.

1320. Application of Debye's Theory of Polar Molecules to Solid Dielectrics. B. J. O'Kane. *Phil. Mag.* 21. *pp.* 369–383, *Feb.*, 1936. *Supplement.*—The paper deals with the results of tests on three fatty acids—palmitic, oleic, and stearic. The variation of power factor and permittivity with temperature and frequency are shown. The frequency range was from 11,000 to $12\cdot5 \times 10^6$ ~. Measurements of the d.c. conductivity were also taken. The Debye dipole theory has been shown to be applicable to certain solid non-crystalline dielectrics by Gemant, assuming that the substance has a finite viscosity. It is found that if the ordinary expression giving the ratio between the viscosities of liquids at different temperatures is applied in the expression given by Debye for the power factor of a dielectric, in terms of the internal viscosity of the medium in which the dipole is assumed to move, that the calculated curves for variation of power factor with temperature agree closely with experiment both for pure oleic acid and its mixtures with palmitic or stearic acids. It would appear, therefore, that there is some property of the substance analogous to the macroscopic viscosity of liquids which obeys the ordinary rules for variation with temperature. With this assumption the Debye theory can be applied to solid dielectrics. AUTHOR.

1321. Dielectric Constants and Conductivity of Gelatin Sols and Gels. A. Piekara and B. Piekara. *Kolloid Zeits.* 73. *pp.* 273–276, *Dec.*, 1935.—The authors carried out a series of investigations on the changes in the dielectric constant with changes in temperature. At the same time they studied the changes which take place in conductivity with changes in temperature, particularly when gelatin sols change into gels and gels into sols. The dielectric constant was determined by a resonance method using a wave-length of about 200 m. An electrolyte-free gelatin was used. J. K.

1322. Dispersion of Conductance and Dielectric Constant in Dilute Solutions of Strong Electrolytes. J. W. Williams and O. M. Arnold. *Acta Physicochimica,* 3. 5. *pp.* 619–632, 1935. *In English.*—Measurements of the h.f. conductance and dielectric constant of very dilute electrolyte solutions are found to be in agreement with the Debye-Falkenhagen dispersion theory as regards changes in the valence type and concentration of the dissolved salt. Thus, the theory of interionic attraction accounts for the dispersion behaviour of an ideal electrolyte. Any decrease in the dielectric constant in salt solutions caused by saturation of the molecules of the liquid by intense electric fields arising from the dissolved ions, is small. The observed increases in susceptibility are due to interionic couplings. E. R.

1323. Dielectric Constants of Strong Electrolytes and the Debye-Falkenhagen Theory. M. Jezewski. *Phys. Zeits.* 37. *pp.* 52–55, *Jan.* 15, 1936.—This investigation continues previous work [see Abstract 4652 (1933)] with an improved resonance method which is described in detail. The data obtained taken in conjunction with the results of other authors establish the following facts anticipated by the Debye-Falkenhagen theory. All electrolytes of equal valency at the same concentration give the same changes of dielectric constant with respect to water. The excess in the constant increases with increasing valency of the electrolyte and with increasing temperature especially in the dispersion region, whereas it decreases with decreasing wave-length. The value of the excess calculated on the Debye-Falkenhagen theory for uni-univalent and di-divalent electrolytes agrees in the region of weak concentrations ($0\cdot002$–$0\cdot003$ N) quantitatively with the experimental results within the limits of error. The measurements of Wenk and Fischer are confirmed for higher concentrations. The increase of dielectric constant for $Ba_2[Fe(CN)_6]$ is even smaller at lower concentrations than the value calculated from the Debye-Falkenhagen theory. The author concludes from his data that a factor must exist to account for this diminution, *e.g.* orientation of the dipole in the strong ionic fields, which comes into effect at concentrations greater than 0·002 or 0·003 *N*. H. H. Ho.

1324. Dielectric Polarisation and Molecular-Compound Formation in Solution. D. P. Earp and S. Glasstone. *Chem. Soc., J. pp.* 1709–1723, *Dec.*, 1935.—Dielectric polarisation measurements have been made for mixtures of ethyl, isopropyl, and $\beta\beta^1$-dichlorodiethyl ethers with a number of halogen derivatives of methane and ethane, in which molecular-compound formation is expected to take place and from the molar polarisations of the separate constituents, it is concluded that compound formation in the cases considered involves introducing a new coordinate linkage which contributes to the dipole moment. In mixtures of acetone, quinoline, and dioxan with some halogenomethanes, compound formation is again shown to occur, a new linkage being formed between the constituent molecules. The authors suggest that the same type of linkage occurs in compounds between nitrogenous bases and phenols, and between certain nitro-compounds and hydrocarbons. J. K.

1325. Permanent Electric Moment and the Structure of Phosphorus Pentachloride. P. Trunel. *Comptes Rendus*, 202. *pp.* 37–39, *Jan.* 6, 1936.—A previous determination by Simons and Jessop [see Abstract 2760 (1931)] in CCl_4 solution gave the molecular polarisation of PCl_5 as 33 cm.^{3} and to be independent of temperature, a conclusion which implies that the moment is zero and thereby indicates a symmetrical structure for the compound. The author has redetermined the constants both in CS_2 and in CCl_4 solution, and has established the existence of a permanent moment, *viz.* $\mu = 0 \cdot 8(7)$D. In consequence PCl_5 possesses a non-symmetrical structure which may be explained either by the non-identity of the 5 Cl atoms attached to the P atom, or by the non-planar character of the molecule. A simple consideration of the electric moment does not enable a decision between these two hypotheses. H. H. Ho.

1326. Dipole Moments of Ethyl, Phenyl and α- and β-Naphthyl-iso-Cyanates. E. G. Cowley and J. R. Partington. *Chem. Soc., J. pp.* 45–47, *Jan.*, 1936.—The dipole moments in Debye units of ethyl (2·81), phenyl (2·28), α-naphthyl (2·30), and β-naphthyl (2·34) *iso*cyanates, measured in benzene solution at 20°, are in agreement with a linear structure for the *iso*cyanate group. It is pointed out that this conclusion is supported by the Raman spectra of these compounds. It is shown that the *iso*cyanate and the *iso*thiocyanate group are similar in configuration. AUTHORS.

1327. Dipole Moments of Five-Membered Nitrogen Ring Compounds. E. G. Cowley and J. R. Partington. *Chem. Soc., J. pp.* 47–50, *Jan.*, 1936.—The following moments (in D) are measured, and the results discussed: indole 2·05, and skatole 2·08, in benzene; carbazole 2·09, isatin 5·72, phthalimide 2·10, and succinimide 1·54, in dioxan. AUTHORS.

1328. Dipole Moments of Acid Halides and of Phosphorus Oxychloride. G. T. O. Martin and J. R. Partington. *Chem. Soc., J. pp.* 158–163, *Jan.*, 1936.—The dipole moments of acetyl, propionyl, *n*-butyryl, *n*-valeryl, and *iso*valeryl chlorides are measured, and it is shown that the moment increases in the series only as far as the second. An explanation for the large value of the moment of acetyl chloride is suggested. The moments of acetyl bromide and iodide are compared with that of acetyl chloride. The moments of chloro- and trichloro-acetyl chloride can be explained on the assumption that the $\mathrm{C}\!\ll\!\begin{smallmatrix}\mathrm{O}\\ \mathrm{Cl}\end{smallmatrix}$ moment acts at an angle of 16° to the direction of the C-C axis. From the moment of phosphorus oxychloride a value of the P → O moment is found.

AUTHORS.

***1329. Influence of a Magnetic Field on the Dielectric Constants of Gaseous and Liquid Nitrogen and Oxygen. A. C. Young.** *Canad. J. of Research*, 13. *Sect. A. pp.* 111–119, *Dec.*, 1935.—The results of a determination of the effect of a magnetic field on the dielectric constants of gaseous and liquid oxygen and nitrogen are given. With the gases a balanced resonance method was used, and with the liquids, a special bridge. The only positive result obtained was with gaseous oxygen at a pressure of 100 atm., and this can be accounted for quantitatively by the increased pressure of the oxygen in the magnetic field. AUTHOR.

1330. Effect of Magnetic Field on Dielectric Constant of Liquids. A. Piekara. *Comptes Rendus*, 202. *pp.* 206–207, *Jan.* 20, 1936.—No appreciable change was observed in the dielectric constant in a field of 20,400 gauss, $\Delta\epsilon$ was < 6, 10, and 10×10^{-6} for C_6H_{14}, CS_2 and C_6H_6 respectively; for $PhNO_2$ it was 6×10^{-4}, but this was uncertain by reason of the conductivity of $PhNO_2$. C. A. S.

See also Abstracts 1053, 1063, 1182.

ELECTROCHEMISTRY.

1331. Coefficient of Activity of Ions. Marguerite Quintin. *Comptes Rendus*, 202. *pp.* 123–125, *Jan.* 13, 1936.—From determinations of E_{Cd} and E_{Cl} for varying values of m in the cells Cd (amalgam 2 phases) | $CdCl_2$, m | KCl, satd. | KCl 0·1N | Hg_2Cl_2 | Hg and Ag | AgCl | $CdCl_2 \cdot m$ | KCl, satd. | KCl 0·1 N | Hg_2Cl_2 | Hg the values of $(E_0)_{Cd}$ and $(E_0)_{Cl}$ are deduced as 0·3494 and −0·2242 respectively, and therefrom a_{Cd} and a_{Cl}, a being the parameter of Debye's theory, as 5·4 and 2 Å respectively. The value for a_{Cd} agrees fairly well with that, 6 ± 1 Å, found previously by the author. [See Abstract 3156 (1935).] C. A. S.

1332. Activity Coefficients of Lead Chloride in Aqueous Solutions of Barium Nitrate. H. D. Crockford and H. O. Farr, Jr. *Am. Chem. Soc., J.* 58. *pp.* 87–89, *Jan.*, 1936.—The activity coefficients of lead chloride in 24 solutions of barium nitrate are determined. In series I the ratio of the molalities is kept constant. In series II and III the lead chloride and barium nitrate are respectively held constant. From the activity coefficients the $\bar{a}$ parameters are calculated by means of the extended equation of La Mer, Gronwall and Greiff. The values so obtained are used to check the equations of Crockford and Thomas concerning the ion size parameter in mixtures of electrolytes. The need for the consideration of the $\bar{a}$ parameter value in mixtures of electrolytes at constant ratio of molality is demonstrated. AUTHORS.

1333. Chemical Theory of Electrolytes. M. Ussanowitsch. *Acta Physicochimica*, 3. 5. *pp.* 703–710, 1935. *In English.*—An equation expressing the dependence of electric conductivity on concentration is derived for all concentrations on the assumption that the electrolytes in binary systems are the compounds formed between the components. The formation of these compounds is considered to obey the law of mass action. The conductivity of a solution is assumed to be proportional to the concentration of the electrolyte. F. J. B.

1334. Electrolysis of Aqueous Solutions of Alkali Chlorides with Graphite Electrodes. W. S. Joffe and M. M. Stroganow. *Zeits. f. Elektrochem.* 42. *pp.* 71–85, *Feb.*, 1936.—The following subjects are investigated experimentally: Current distribution between the surface and pores of graphite anodes and the effects of impregnating the anodes upon this distribution; simultaneous production of Cl_2 and O_2 by the electrolysis of NaCl solutions, using magnetite or graphite anodes; effect of the impregnation of graphite anodes upon the anode process; electrocapillary phenomena exhibited by impregnated and non-impregnated graphite anodes. J. S. G. T.

1335. Transference Numbers in Dilute Solutions from Limiting Ionic Conductances. B. B. Owen. *Am. Chem. Soc., J.* 57. *p.* 2441, *Dec.*, 1935.—A semi-empirical equation is used to calculate the transference numbers of some strong electrolytes, chiefly the chlorides of Li, Na and K. It is shown to be formally equivalent to that of Longworth. The equation fails to give results in agreement with the known transference data for $AgNO_3$ and KNO_3, for $CaCl_2$ and $BaCl_2$ and for Na_2SO_4. F. J. B.

1336. Energy Levels in Electrochemistry. W. D. Bancroft and J. E. Magoffin. *Am. Chem. Soc., J.* 57. *pp.* 2561–2565, *Dec.*, 1935.—The oxidation of dilute aqueous H_2SO_3 or Na_2SO_3 is shown to be an irreversible reaction because for reduction to take place the system must pass through an energy level or energy hump which is higher than the energy level for nascent hydrogen as obtained by electrolysis. In H_2SO_4 solutions and presumably in all other solutions, the energy hump decreases with increasing concentration, rising temperature and activating adsorption. The stabilities of $NaClO_3$ and $NaClO_4$ relatively to NaClO are due to the intermediate energy levels which must be surmounted if reduction is to take place. $NaClO_3$ is adsorbed and activated by pulverulent copper to such an extent that it could be reduced by hydrazine. There is no reason for making any fundamental distinction between hydrogenation and reduction, and Conant's work on irreversible reductions is shown to be in general harmony with the present work, if Conant's two assumptions are rejected. F. J. B.

1337. Absolute Single Electrode Potential. K. Hirota and T. Murata. *Chem. Soc. Japan, Bull.* 10. *pp.* 594–596, *Dec.*, 1935.—The absolute potential of a Hg electrode in *N* KNO_3 solution is measured. The Hg is allowed to flow down from a wide vessel and is ejected through an orifice 0·08 mm. in diameter, into the KNO_3 solution. A potential varying from zero to 1·5 V is applied between the Hg in the wide vessel and that in the solution, and the corresponding potential of the Hg jet is measured against the normal calomel electrode. The height of the jet is measured to within 0·01 mm. Two series of measurements give the values for the potential as, $0{\cdot}560 \pm 0{\cdot}004$ V at 20·1° C., and $0{\cdot}567 \pm 0{\cdot}005$ V at 21·0° C. The mean $0{\cdot}563 \pm 004$ at 20·6 is in good agreement with the recorded values. F. J. B.

1338. Volta Effect of Electrolytic Solutions against Water; Characteristics of Acidity and Basicity. Suzanne Veil. *Comptes Rendus*, 202. *pp.* 121–123, *Jan.* 13, 1936.—If two Pt wires are inserted at different points in a sheet of gelatin they show a p.d. due to the hetrogeneity of the gel. If one is inserted in a drop of pure water lying on the gel the

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p.d. remains practically unchanged. If the second is inserted into a drop of solution of some salt similarly situated a different p.d. is observed, which is termed the electrometric potential (e.p.) of that solution. It is deemed positive if the positive pole is in the solution, negative if that pole is in the water. It is positive for solutions that redden litmus, negative for such as turn them blue, *i.e.* acidity and basicity are correlated with the Volta effect of the solution against water. [See Abstract 3099 (1934).]

C. A. S.

1339. Simultaneous Kathodic and Anodic D.C. Polarisation of Electrodes. Part II. P. S. Tutundžić. *Zeits. f. Elektrochem.* 42. *pp.* 21–27, *Jan.*, 1936.—This work continues Part I [see Abstract 3995 (1935)] and deals with working electrodes of Pt, Pd and Au, whereby the influence of a continuous d.c. of varying direction, voltage and strength upon the potential and decomposition voltage in 2*N* H_2SO_4 at room-temperature is investigated. By electrolytic depolarisation of the anodes, the oxygen-deposition potential is strongly displaced towards the negative in order to approach, by equality of the opposed polarisations, the common potential of the kathode, *viz.*, $+ 0 \cdot 927 \pm 0 \cdot 005$ V. The end-potential for the current density 0A/cm.^{2} was for Pt, $+ 0 \cdot 887$ V; for Pd, $+ 0 \cdot 917$ V; and for Au, $+ 0 \cdot 950$ V, respectively. The water-formation potential attained for Pd was about $+ 0 \cdot 920$ V and is regarded as a further confirmation of the previous result $+ 0 \cdot 927 \pm 0 \cdot 005$ V. At smooth Pt the common potential of $+ 1 \cdot 00$ V is attained at about 85 % simultaneous kathodic polarisation, and is independent of the current density; and for smooth Pd and Au the above occurs at about 90 % kathodic d.c. polarisation. The potentials of the anodes are displaced towards the positive side by anodic over-polarisation of the working anodes, a phenomenon which also occurs at Pt and Pd for the higher current densities. A whole series of O_2 and H_2 deposition potentials are included in the paper for various current densities and voltages.

H. H. Ho.

1340. Mechanism of Electrolytic Processes. Part I. Anodic Oxidation of Metals of the Platinum Group. J. A. V. Butler and G. Drever. *Faraday Soc., Trans.* 32. *pp.* 427–435, *Feb.*, 1936.—When electrodes of Pd, Rh and Ir are anodically polarised in acid and alkaline solutions, an adsorbed layer of oxygen is formed prior to the establishment of the oxygen overvoltage, similar to that previously demonstrated in the case of Pt. With Pd and Rh a second stage in the oxidation has been observed, *viz.*, the slow formation of oxides of a peroxidic character, which are reduced kathodically at a more positive potential than the adsorbed oxygen. The conditions of formation of these oxides is investigated, and a mechanism of the oxidation suggested. AUTHORS.

1341. Mechanism of Electrolytic Processes. Part II. Electrolytic Oxidation of Sodium Sulphite. J. A. V. Butler and W. M. Leslie. *Faraday Soc., Trans.* 32. *pp.* 435–444, *Jan.*, 1936.—The conditions under which the electrolytic oxidation of sodium sulphite occurs in buffer solutions of various pH is examined. It is shown that in pH = 7 the oxidation takes place at a more negative potential than that at which adsorbed oxygen is formed. Since no other primary process is observed in this region with the buffer solution alone, it is concluded that the oxidation takes place in this solution by the direct transfer of electrons from the sulphite ions to the electrode. In solutions of pH = 9 the oxidation occurs in the same region as that in which adsorbed oxygen is formed so that in these solutions oxidation by adsorbed oxygen is a possibility. The effect of various added salts is studied and it is found that in the case of manganous salts, which are much the most effective, the suppression of the initial stage of the electrolysis is due to the formation of a film of MnO_2. The results of this investigation are not in accordance with Glasstone and Hickling's hydrogen peroxide theory. An alternative mechanism is suggested. AUTHORS.

See also Abstracts 1163, 1267.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

1342. Emission of Positrons by a Th B + C Source. S. de Benedetti. *Comptes Rendus*, 202. *pp.* 50–52, *Jan.* 6, 1936.—By a similar method [see Abstract 2738 (1935)] it is shown that the number of positrons produced by the action of radiation from Th B + C on screens of cellophane, Al and Pb, after allowing for those arising in the source and traversing the screens is in accordance with the theory of materialisation of γ-rays. No production of positrons by radiation other than γ-rays is detectable after such radiation has passed through a thickness of matter equal to $0 \cdot 55$ gm./cm.^{2} C. A. S.

1343. Absorption in Matter of Protons of Great Energy. J. Solomon. *Comptes Rendus*, 202. *pp.* 204–206, *Jan.* 20, 1936.—The loss of energy by radiation may be due to interaction between the field of the incident proton and that of a nucleus or of an atomic electron. It is shown to be negligible in either case. Protons of great energy therefore lose their energy essentially by ionisation, and for velocities approaching that of light they will be more penetrating than electrons, while the reverse is the case for smaller velocities; the transition occurs at about 50×10^6 eV alike for H_2O or Pb. [See Abstract 857 (1936).] C. A. S.

1344. Radial Distribution Method of Interpretation of Electron Diffraction Photographs of Gas Molecules. L. Pauling and L. O. Brockway. *Am. Chem. Soc., J.* 57. *pp.* 2684–2692, *Dec.*, 1935.—It is shown by empirical tests that the radial distribution function given by a sum of Fourier terms corresponding to the rings observed on an electron diffraction photograph of gas molecules (using visually measured ring diameters and estimated intensities) provides values of the important interatomic distances accurate to 1 or 2 % (probable error). The substances used in the tests include CCl_4 and other tetrahalides, Br_2, Cl_2 C_6H_6, CS_2 and COS. The radial distribution method of interpretation is applied to a number of molecules previously investigated, and revised values of interatomic distances and bond angles, obtained by considering the results of this method as well as of the usual visual method, are presented. It is pointed out that the radial distribution method is particularly satisfying in that it leads directly to the values of the important interatomic distances in the molecule, thus eliminating many possible models and usually limiting the molecule to the structures represented by small ranges of values of the structural parameters. [See following Abstract.] H. H. Ho.

1345. Electron Diffraction Investigation of Phosgene, the Six Chloroethylenes, Thiophosgene, α-Methylhydroxylamine and Nitromethane. L. O. Brockway, J. Y. Beach and L. Pauling. *Am. Chem. Soc., J.* 57. *pp.* 2693–2704, *Dec.*, 1935.—In phosgene, thiophosgene and the six chloroethylenes, the C-Cl distances are found to vary between $1 \cdot 67$ and $1 \cdot 73$ Å, being between 5 and 2 % less than the normal single bond value 1·76 Å. This decrease is due to the partial double bond character caused by resonance resulting from the conjugation of an unshared pair of electrons on the Cl atom with the adjacent double bond. The values found for the angle Cl–C–X are somewhat smaller than the tetrahedral value 125° 16′ for the angle between a single bond and a double bond, as a result of the same phenomenon. A detailed discussion of these effects is reserved for another paper. For the other interatomic distances the values found are in good agreement with the table of covalent radii. In phosgene the C=O distance has the double bond value 1·28 ± 0·02 Å, and for thiophosgene the double bond value 1·63 Å for the C = S distance. The N–O distance 1·21 ± 0·02 Å for the nitro-group in nitromethane is close to the double bond value 1·22 Å. The distances N–O = 1·37 ± 0·02 Å, and C–O = 1·44 ± 0·02 Å in α-methylhydroxylamine and C–N = 1·46 ± 0·02 Å in nitromethane agree well with the single bond values 1·36, 1·43 and 1·47 Å, respectively, given by the table of radii. [See preceding Abstract.]. H. H. Ho.

1346. Errors of Approximation in Jeffreys' Phases. F. L. Arnot. *Cambridge Phil. Soc., Proc.* 32. *pp.* 161–178, *Jan.*, 1936.—The errors occurring in a large number of Jeffreys' phases for neutral chlorine are determined. A discussion of the source of these errors is given, from which it appears that errors in the phases of zero order and of order unity are due to a cumulative error over the range of integration. A method of correcting for this error is obtained. This method is of easy practical application, and it reduces the error almost to zero for phases of these orders. The error occurring in higher order phases is found to be mainly due to errors in the two $\pi/4$ terms, which take into account the exponential tails of the waves in the totally reflecting region. For phases of high order these errors in the two $\pi/4$ terms cancel each other, and consequently the total error in phases of high order is practically zero. A correction graph for the zero-order phase is given from which the error in this phase for atoms of atomic number up to 36 can be read off. The graph is such that an extrapolation to higher atomic number would not involve much error. [See also Abstract 4709 (1934).] AUTHOR.

1347. Diffuse Rings Produced by Electron Scattering. L. H. Germer. *Phys. Rev.* 49. *pp.* 163–166, *Jan.* 15, 1936.—Two diffuse rings produced by electrons scattered from polished metal surfaces are widely accepted as evidence that such surfaces are amorphous. Similar rings are, however, formed by electrons scattered from vaporised ZnS, and from unpolished surfaces of SiC and Cu_2O, all of which are very probably crystalline. These experiments seem to vitiate the previous interpretation of these rings, although they cannot be construed as definite evidence against an amorphous layer on polished metals. AUTHOR.

1348. Theory of the Scattering of Slow Electrons by Diatomic Molecules. J. B. Fisk. *Phys. Rev.* 49. *pp.* 167–173, *Jan.* 15, 1936.—The problem of the Ramsauer effect for diatomic molecules is treated in a manner analogous to that used by Allis and Morse for atoms. The molecule is represented by a simplified potential field in spheroidal coordinates, and an exact solution is obtained, valid for all velocities of incident electrons. The calculations of " total cross section for elastic scattering " are made in terms of three parameters whose values for a given molecule are definitely determined from data of band spectroscopy and from Slater's rules for atomic shielding constants. Calculations are carried out in the region of incident electron velocities 0 to 40 V for N_2,

O_2, and H_2, for which molecules excellent agreement is obtained with experiment. AUTHOR.

1349. Proof of the Aberrations of an Electron Lens by Point Imagery. K. Diels and M. Knoll. *Zeits. f. techn. Physik*, 16. 12. *pp.* 617–621, 1935.—The astigmatism of oblique incident pencils is examined in a Braun tube in which inclined electrostatic and magnetic lenses of symmetrical and elliptical form are used for focusing. Coma and aberrations dependent on aperture are demonstrated. The type of aberration observed agrees closely with its optical analogue. H. J. H. S.

1350. Relation between Electron Lenses, Mirrors and Convergence. W. Henneberg and A. Recknagel. *Zeits. f. techn. Physik*, 16. 12. *pp.* 621–623, 1935.—An electrical " Einzellinse " (same potential on either side of the lens) with a negative lens potential becomes an electron mirror if the energy of the incident electrons is sufficiently small. As the energy decreases, the lens acts first as a converging lens, then as a convex mirror and finally as a concave mirror. The ray paths and focal length curves (for different lens potentials) are given for a lens acting as a mirror and the intensity of the transmitted beam is also considered. H. J. H. S.

***1351. Thyratron Selector for Double Trace Kathode-Ray Oscillograph. H. K. Hughes.** *Rev. Sci. Instruments*, 7. *pp.* 89–92, *Feb.*, 1936.—A circuit whereby two entirely independent wave-forms may be observed simultaneously on the screen of the kathode-ray oscillograph is described. The two curves to be observed are fed through separate transformers to suppressor-modulate two 57 valves. By a special combination of a thyratron and an ordinary neon diode, a square wave is obtained which is applied to the control grids of the 57's, biasing first one, then the other to cut-off. Data are given for grid extinction of the thyratron. The uses are discussed and illustrated. AUTHOR.

See also Abstracts 970, 1048, 1154, 1198, 1199, 1299, 1300, 1353, 1382, 1383.

ELECTROSTATICS.

1352. Problem of Dirichlet for an Ellipsoid. I. S. Sokolnikoff and E. S. Sokolnikoff. *Terr. Mag.* 40. *pp.* 433–442, *Dec.*, 1935.—The electrical field produced by a distribution of charge in equilibrium on an oblate or prolate ellipsoid of revolution lying midway between two parallel conducting planes at zero potential is considered. A class of harmonic functions is constructed which satisfy the boundary conditions on the planes, and they are combined so as to satisfy the boundary conditions on the surface of the ellipsoid. The calculation of the potential function is reduced to the solution of an infinite system of linear algebraic equations in infinitely many unknowns. An approximate solution only of the system can be given and a scheme of successive approximations is outlined which may prove of value in treating similar problems. Formulæ for calculating the capacity of the system are also given. R. S. R.

1353. Mutual Energy in Systems of Vibrating Particles and a Suggestion Regarding Electrostatic Energy. E. T. Jones. *Phil. Mag.* 21. *pp.* 337–355, *Feb.*, 1936. *Supplement.*—The object of the present paper is to enquire whether the electrostatic attractions and repulsions of stationary electrons cannot be traced to the interaction of the wave-systems associated with them. The approach of two similar electrons from an infinite distance is considered, and the consequent increase in energy is equated to the electrostatic energy. For very close approach the force does not follow the inverse square law, the factor representing the deviation being about 0·99 at 10^{-11} cm. and 0·88 at 10^{-12} cm. The theory predicts an annihilation of electrons of opposite sign (for which there is some experimental evidence) if the distance of approach is such that the coupling between them is a maximum, when their frequency is zero. A variability of mass is also indicated when like or unlike electrons approach. A number of other regular systems of three or more electrons are also considered. The theory is successful in interpreting the electrostatic energy of these systems in terms of the interaction of vibrating particles.

C. J. B. C.

See also Abstract 1307.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

*1354. **Method of Investigating the Hall Effect. H. S. Hatfield.** *Phys. Soc., Proc.* 48. *pp.* 267–276, *March* 1, 1936.—A cylindrical coil of thin metal strip of width equal to the length of the coil is connected to a galvanometer and set between the poles of a magnet rotating about the axis of the coil, the field being at right angles to the latter direction; or a stationary three-pole magnet fed with three-phase current may be used. The galvanometer indicates a steady direct e.m.f. due to the sum of two Hall e.m.fs. per turn of the coil, resulting from the action of the field upon the currents induced in the coil by the rotation of the field. The e.m.fs. are much larger than those obtainable by ordinary methods, and there are no thermoelectric or other disturbing effects. An approximate formula is derived, and is shown to agree roughly in the case of seven metals with data taken from tables. It is suggested that the method might be of use for comparative work at extreme conditions. AUTHOR.

1355. **Ferromagnetic Rise of Resistance of Copper-Nickel Alloys. B. Svensson.** *Ann. d. Physik,* 25. 3. *pp.* 263–271, *Feb.,* 1936.—The specific electric resistance of 9 Cu-Ni alloys with variations of concentration of about 10 % is measured between 0° C. and 500° C. Krupkowski and de Haas have carried out such measurements for the temperature region − 258° C. to 0° C. and from their results completed by those of the author, the ferromagnetic rise of resistance in its dependence on the concentration is calculated. J. J. S.

MAGNETISM AND ELECTROMAGNETISM.

1356. **Singular Magnetic Poles. B. O. Grönblom.** *Zeits. f. Physik,* 98. 3–4. *pp.* 283–285, 1935.—It is shown theoretically that in a system consisting of a stationary singular magnetic pole, an electron and any electromagnetic potential field, the energy, as well as the transition probability are independent of the positions of the nodal lines. H. J. H. S.

1357. **Appearance of Spin in Ferromagnetic Crystals. R. Gans.** *Ann. d. Physik,* 24. 8. *pp.* 680–696, *Dec.,* 1935.—The disturbance which occurs in a ferromagnetic crystal with cubical symmetry under the action of tensile stress of a given orientation is calculated for the general case and then certain simple cases are worked out. The magnetisation curve of a ferromagnetic single crystal with cubical symmetry under the action of a large tension or pressure is calculated for the case when the applied field is in the direction of the tension. H. J. H. S.

***1358. Multi-Lamellar Cylindrical Magnetic Shields. L. R. Walker.** *Rev. Sci. Instruments*, 6. *p*. 416, *Dec*., 1935.—An approximation is obtained for calculating the shielding coefficient by the application of Sterne's theory [see Abstract 4723 (1935)]. It has the advantage that it is easily possible to calculate the number of shells required to produce a specified shielding factor. G. E. A.

1359. Analysis of the Process of Magnetisation. K. H. R. Weber. *Zeits. f. Physik*, 98. 3–4. *pp*. 155–180, 1935.—The mechanism of magnetisation put forward by Weiss is described and the theoretical deductions derived from it are compared with experimental observations on a mechanically treated Ni wire; the latter are obtained by means of an astatic magnetometer system. The agreement between theory and experiment is good, but 3 small discrepancies are found; suggestions are put forward to account for these. H. J. H. S.

1360. Experimental Proof of the Akulov Theory of Coercive Force. W. S. Messkin and B. E. Somin. *Zeits. f. Physik*, 98. 9–10. *pp*. 610–623, 1936.—The earlier work which was thought to establish the Akulov theory [see Abstract 3227 (1933)] is now critically examined and shown not only to afford no proof for the validity of the theory, but in some cases to establish the exact opposite. An experimental investigation of a series of alloy systems, *viz.*: Fe-Al, Fe-Ti, Fe-Mo, Fe-W and Fe-Ni-Al, has proved that the Akulov theory in its present form cannot be confirmed. H. H. Ho.

1361. Curie Point of Nickel. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc*. 3. *pp*. 127–131, *Jan*., 1936.—The conventional Curie point is deduced from the results of Weiss and Forrer for nickel. The value of θ (in °C.) obtained by extrapolation of the steepest part of the σ, T curve is given closely by $\theta = 361{\cdot}5 + 1{\cdot}6 \times 10^{-3}$ H. Extrapolation of the steepest part of the σ_0^2, T curve gives approximately $\theta = 357{\cdot}5 + 0{\cdot}8 \times 10^{-3}$ H. The form of the σ_0, T curve giving the variation with temperature of the intrinsic magnetisation in zero field (deduced by extrapolation, using the magneto-caloric results) is discussed. It is shown that the experimental results do not enable a unique Curie temperature to be deduced such as is indicated by the idealised theory. The necessity is emphasised of indicating clearly the method used in deducing Curie temperatures when these are given on the basis of experimental results; particularly in connection with possible differences in the Curie temperatures of materials of nearly the same composition. AUTHOR.

1362. Nonorthogonality and Ferromagnetism. J. H. van Vleck. *Phys. Rev*. 49. *pp*. 232–240, *Feb*. 1, 1936.—The calculations in Heisenberg's theory of ferromagnetism have been questioned by Inglis and others on the ground that the error resulting from the nonorthogonality of the wave functions may possibly increase without limit when the number of atoms becomes arbitrarily large. It is now proved that this difficulty does not really arise. Semiquantitative formulæ are given to correct for the error due to nonorthogonality, which is shown to be of the order $2z\delta^2$ relative to unity, where z is the number of neighbours and δ is the overlap integral. A supplementary note is included on a new method of approximating the partition function in Heisenberg's theory. This approximation should be somewhat better than the assumption of a Gaussian distribution, but agrees even worse with experiment, if orthogonality be assumed. Actually, the influence of nonorthogonality is sufficiently large to render uncertain any attempt to deduce exactly the critical conditions (minimum number of neighbours, etc.) necessary for ferromagnetism. AUTHOR.

1363. Magnetic Anisotropy of Natural Substances. Part I. Mother of Pearl. P. Nilakantan. *Indian Acad. Sci., Proc.* 2A. *pp.* 621–629, *Dec.*, 1935.—The magnetic anisotropies of the nacre of *Turbo, Haliotis, M. margaratifera, Mytilus viridis* and *Nautilus pompilius*, respectively, are determined. The observations indicate that the *c*-axes of the aragonite crystals are in every case normal to the elementary laminæ. A random orientation of the *a* and *b* axes in *Turbo* and *Haliotis*, and a preferred orientation, with the *a*-axes approximately along the line of growth for *M. margaratifera* and *Mytilus viridis*, are tentatively suggested. A quasi-crystalline structure for conchyolin is suspected. The absolute susceptibilities of the shells are also determined. AUTHOR.

1364. Absolute Measurement of Coefficients of Magnetisation and Magnetic Susceptibilities of Liquids. G. Dupouy and C. Haenny. *J. de Physique et le Radium*, 7. *pp.* 23–29, *Jan.*, 1936.—A modification of Gouy's method is fully discussed. It has the advantage of furnishing simultaneously the absolute values of the coefficients of magnetisation and the susceptibilities of liquids either in the pure state or as solutions. The method has been tried on aqueous and alcoholic solutions of cerium nitrate, chloride and acetate. [See Abstract 5249 (1934).] W. R. A.

1365. Magnetic Studies on Graphite and Graphitic Oxides. N. Ganguli. *Phil. Mag.* 21. *pp.* 355–369, *Feb.*, 1936. *Supplement.*—The principal susceptibilities of graphite crystal along its vertical axis and along directions in the basal plane are found to be -22×10^{-6} and $-0{\cdot}5 \times 10^{-6}$ respectively per gm. When the crystal is treated with a mixture of concentrated sulphuric and nitric acids to form " blue graphite " the abnormal diamagnetism along the vertical axis is nearly destroyed, whereas the diamagnetism along directions in the basal plane remains practically unaltered. The anisotropy of " blue graphite " is found to be of the same order of magnitude as in aromatic molecules containing several condensed benzene nuclei, *viz.*, $1{\cdot}3 \times 10^{-6}$ per gm. content of carbon. A diminution in the size of graphite particle has nearly the same effect as oxidation, namely, to destroy the abnormal diamagnetism along the vertical axis without appreciably affecting that along directions in the basal plane. This may be attributed to a breaking up of the metallic linkages in graphite which are responsible for its abnormal diamagnetism. AUTHOR.

1366. Magnetic Forces in a Rectangular Circuit. F. F. Cleveland. *Phil. Mag.* 21. *pp.* 416–425, *Feb.*, 1936. *Supplement.*—The standard force equation, and Ampère's force equation for the magnetic force between current elements, are applied to determine the forces in a rectangular circuit, one side of which is mechanically separable from the other three. In order to explain the observed forces by the use of the standard equation, it is necessary to make the doubtful assumption that a part of the rectangular circuit can lift itself. Ampère's equation gives a reasonably correct value of the forces without the necessity of making this assumption. AUTHOR.

1367. Dependence of Volume Magnetostriction and Weiss Factor on Temperature and Lattice Constant. M. Kornetzki. *Zeits. f. Physik*, 98. 5–6, *pp.* 289–313, 1935.—If a ferromagnetic body shows a volume magnetostriction in the region of saturation, its spontaneous magnetism alters with pressure. An explanation is offered on the assumption that the Weiss factor and hence the Curie point depend on the volume of the material. An expression is derived whereby the displacement of the Curie point with volume, pressure and temperature may be deduced from measurements of the volume effect. The displacement of the Curie point with volume may be related to an alteration of the Heisenberg exchange interval with lattice constant. In the paramagnetic region the volume effect increases with the square of the field strength, as predicted by the theory. The volume effect is measured over the range 20–90° C. for Fe, Fe-Ni and Ni-Cu alloys and the displacement of the Curie point with volume and temperature is deduced. For Fe and the Fe-Ni alloys the displacement per 1° C. is of the order 0·3–0·5. In the Cu-Ni alloy a change of sign of the volume effect at −2° C. is predicted. The temperature variation of the reciprocal of the susceptibility at temperatures above the Curie point is deduced and a correcting term is applied to the older Weiss formula. An evaluation of the Weiss factor is made and a correcting term is derived which may be applied to the formula for the magneto-caloric effect. H. J. H. S.

1368. Magnetic Properties of Nickel Wire under Great Torsion. R. Gans. *Ann. d. Physik*, **25**. 1. *pp*. 77–91, *Jan*., 1936.—The magnetisation curve of a strongly twisted Ni wire is derived theoretically with the help of the theory put forward by R. Becker. It is assumed that the torsion is so great that the magnetic crystal energy is negligible compared with the magneto-elastic deformation energy and that the body is isotropic in the elastic and magneto-elastic sense. Certain simple cases are worked out and 2 hysteresis loops are given which are in close agreement with those observed experimentally. The positive and negative Matteucci effects are considered theoretically. If a current is passed through a twisted ferromagnetic wire, an unsymmetrical magnetisation is produced; the theory of this phenomenon is discussed for the case of a longitudinal and a circular field. Certain discrepancies between theory and experiment are pointed out and an attempt is made at reconciliation by considering the influence of crystal energy. H. J. H. S.

1369. Influence of Tension on Magnetisation above the Curie Point. Gertrud Scharff. *Ann. d. Physik*, **25**. 3. *pp*. 223–232, *Feb*., 1936.—By means of an apparatus previously described [see Abstract 4719 (1935)] the influence of tension on the magnetisation of Ni wire is examined. It is found that the Curie point and the true magnetisation are independent of tension, whilst the apparent magnetisation depends on the tension. Apparent magnetisation is found up to 12° C. above the Curie point in fields of 4·6 Oersteds. The initial susceptibility χ_0 above the Curie point is proportional to $1/Z$ for large tensions (Z) and $\chi_0 Z$ has a maximum value below the Curie point, but falls away approximately exponentially above it. H. J. H. S.

***1370. Electromagnets. J. W. A. Chorley.** *M.V. Gazette*. **16**. *pp*. 27–32, *Jan*., 1936.—A brief description is given of a number of electromagnets designed for special purposes: a magnet capable of giving an intense field in a small air-gap and provided with a very efficient cooling system, and magnets for use in α-ray analysis and for work on cosmic rays. In the latter, a high flux density is produced in an air-gap 15 cm. long.

An account is also given of an oil-cooled magnet in which a field of the order of 30,000 gauss is obtainable in a 2-mm. air-gap. H. J. H. S.

See also Abstracts **963, 1025, 1054, 1256, 1313, 1355.**

MEDICAL RADIOLOGY AND ELECTROLOGY.

*1371. **Thermal Measurements in Short-Wave Diathermy. A. Bessemans, A. Rutgers and E. van Thielen.** *Comptes Rendus*, 202. *pp.* 157–159, *Jan.* 13, 1936.—The comparative merits of various types of thermometers, mercury, alcohol, benzene, thermocouple, etc., used in the measurement of tissue temperatures in short-wave diathermy are discussed. In the experiments two types of h.f. field are used, an electric field between condenser plates and a magnetic field near a coil of cable. The glass used in the thermometers is shown to be a source of heat development in the h.f. fields. It is concluded that a quartz thermometer filled with benzene fulfils all the necessary requirements, and does not react directly in any way to short waves. J. E. R.

1372. Biological Measurement of Depth Dosage with 165-kV and 650-kV X-Rays. P. S. Henshaw and D. S. Francis. *Am. J. of Roentgenology and Radium Therapy*, 34. *pp.* 789–797 ; *Disc.*, 797, *Dec.*, 1935.—Any direct relationship between biological action and ionisation measurements, is open to question, particularly since softening of the radiation at a depth of a medium undoubtedly occurs, but is not recorded with use of an ionisation chamber. To investigate this question comparative intensity measurements have been made at 165 kV and 650 kV, the ionisation measurements being compared with measurements upon wheat seedlings and drosophila eggs, the preparation of the material being described and the ionisation chamber being that due to Failla, the construction of which has been published. The organisms used are treated at various depths of paraffin wax phantoms, the procedure being described in detail. Data and curves of the various measurements are provided. It is found that not only are the biological results different from the ionisation measurements, but the biological results differ. Ionisation-chamber measurements were higher than the biological measurements for both voltages used. It is suggested that error arises by basing biological depth doses on ionisation measurements and even biological responses may vary when exposure occurs under different conditions. B. J. L.

*1373. **Capacitor Discharge Apparatus. G. W. Files.** *Am. J. of Roentgenology and Radium Therapy*, 34. *pp.* 798–810, *Dec.*, 1935.—It is often considered that X-ray capacitor apparatus is subject to lack of flexibility of operation, particularly in respect to modern high-speed operation, rendered possible by rapid films and intensifying screens, although the apparatus has advantages of permitting very rapid exposures. The mode of electrical operation is illustrated in terms of an hydraulic analogy, curves for discharge of water from a storage tank, being illustrated, which correspond to theoretical discharge curves of the electrical apparatus. Actual apparatus has been investigated by means of oscillographic curves, these being illustrated and discussed in detail. From the results obtained it is considered that this type of apparatus has definite advantages in respect to very rapid exposures and use of tubes with fine focal spots, that the apparatus is simple in operation, permits ease of duplication and the use of smaller power values. The use is not limited to radiographic procedures of the chest, heart, and alimentary canal, but can be used more generally and, in respect to effective exposure-time values, is the most powerful equipment available. B. J. L.

1374. Radiation by Irradiated Cholesterine. A. H. Roffo and A. E. Roffo, Jr. *Comptes Rendus*, 201. *pp.* 1434–1435, *Dec.* 23, 1935.—It is observed that cholesterine is able to absorb certain wave-lengths and emit others. This is studied for irradiation by sunlight and by light from a mercury-vapour lamp, when the cholesterine is contained in cellophane. The wave-length of the radiation emitted is measured by means of a quartz spectrograph and found to consist of lines at 3533 and 3572 Å. The intensity of the radiation increases with time of exposure. G. E. B.

See also Abstracts 1071, 1072, 1173, 1248, 1249, 1378.

OSCILLATIONS.

1375. Thermal Method of Measuring Loss in Valves. F. P. Cowan. *Rev. Sci. Instruments*, 7. *pp.* 13–16, *Jan.*, 1936.—A common method of determining the power loss in a valve is to note the temperature of the valve under steady oscillating conditions, stop the oscillations by disconnecting the circuit and adjust the anode power to give the same temperature reading. The various methods of determining the equilibrium temperature are discussed and the possible errors disclosed. The author concludes that the two best methods for general use are: (*a*) the attachment of a thermometer to the valve with a small paper cap, and (*b*) a bolometer method with the coil wound round the glass envelope near the anode; in each case a draught shield round the valve is of assistance in maintaining consistent and steady conditions. F. S. B.

1376. Motion of Electrons in Crossed Electric and Magnetic Fields with Space Charge. L. Tonks. *Phys. Zeits. d. Sowjetunion*, 8. 5. *pp.* 572–578, 1935. *In English.*—Braude's view that his solution of this problem for the space-charge limited plane case shows the absence of cut-off by a critical magnetic field [see Abstract 4412 (1935)] is shown to be incorrect. An analysis is given of the nature of the potential distribution and its relation to cut-off. A series of virtual kathodes is found of a peculiar type, having spacing proportional to current. Only that solution which has no virtual kathode is stable and hence of physical significance, except perhaps when a cut-off magnetron is generating oscillations. The theory accounts for the decrease of current in a magnetron as cut-off is approached. [See following Abstract.] J. J. S.

1377. "Cut-Off" in the Plane Magnetron with Space Charge. S. J. Braude. *Phys. Zeits. d. Sowjetunion*, 8. 5. *pp.* 584–586, 1935. *In English.*—The author replies to Tonks' paper [see preceding Abstract] and argues that as Tonks' conclusion agrees with the experimental results of other investigations on analogous questions (cylindrical magnetrons) it may be considered that the real (physical) solution of the present case is given by Tonks, though his own solution from the mathematical point of view is also correct. J. J. S.

*1378. **Valve Amplifier for D.C. W. Holzer.** *E.u.M.* 53. *pp.* 613–618, *Dec.* 29, 1935.—A description of the circuit and construction of a direct coupled resistance amplifier suitable for the amplification of small direct and l.f. voltages. The two-valve amplifier gives a constant voltage amplification of 56,000 : 1 at frequencies up to 100 ∼, but at 500 ∼ the

amplification falls to 41,000 : 1. One application of the apparatus is, in conjunction with a kathode-ray oscillograph, for electrocardiography.
E. W.

See also Abstracts 1294, 1296, 1310, 1351.

PHOTOELECTRICITY.

1379. Becquerel Effect and Photochemical Sensitiveness of Fluorescent Dyes. Cécile Stora. *Comptes Rendus*, 202. *pp.* 48–50, *Jan.* 6, 1936.—The photo-potential of the xanthene dyes is positive, distinguishing them fundamentally from those of the quinone-diimide group. It increases in the order uranine, eosine, erythrosine, *i.e.*, the reverse of that of the fluorescence. It is markedly reduced by hydrosulphites, phenol, amines and $TiCl_3$, but KI while reducing that of erythrosine, increases that of uranine and eosine. The action of gases (O, N and H) also differs for the two groups. These differences are attributed to differences in the chemical constitution. [See Abstract 2772 (1935).] C. A. S.

1380. Inner Photoelectric Effect in Semi-Conductors. H. Fröhlich. *Phys. Zeits. d. Sowjetunion*, 8. 5. *pp.* 501–510, 1935. *In German.*—Calculations are given for the electron distribution function for a semi-conductor illuminated by monochromatic light, and for the Dember effect. D. H. F.

See also Abstract 1114.

PIEZOELECTRICITY.

1381. X-Ray Studies of Crystals Vibrating Piezoelectrically. C. V. Bertsch. *Phys. Rev.* 49. *pp.* 128–131, *Jan.* 15, 1936.—With a Y-cut quartz crystal, vibrations at the low frequency corresponding to the length, and at the high frequencies corresponding to the thickness, cause large increases of intensity of Laue patterns, but only the l.f. vibrations increase the intensity of regular reflection at the crystal faces. With a long X-cut crystal, a definite distinction is found between the regions of nodes and antinodes of motion. Similar vibrations in X-cut and Y-cut crystals have different effects on the X-ray patterns. P. V.

THERMIONICS.

1382. Emission Images of Thoriated Tungsten and Molybdenum. E. Brüche and H. Mahl. *Zeits. f. techn. Physik*, 16. 12. *pp.* 623–627, 1935.—A number of photographs taken with the electron microscope illustrate important phases in the emissive behaviour of thoriated W. On heating the kathode, strongly emitting rings appear (1550° K.), the region inside the rings being a weak emitter. These gradually cohere (1650° K.) and, as the temperature of reduction of the Th is approached (2900° K.), single discrete emitting centres appear, corresponding to the positions of the Th on the surface. At the temperature of activation (2000° K.) the centres combine until an approximately uniform emission is obtained. The activation velocity is greater, the higher the temperature. Activation at 2600° K. leads to the appearance of the surface structure of the W, particularly if the W is thin. It is shown that the Th

emitting centres are not confined to the grain boundaries of the W surface. A number of deductions are made concerning the process of emission.
H. J. H. S.

1383. Electron-Microscope Examination of the Electron Emission from Cold Metals. A. Wehnelt and W. Schilling. *Zeits. f. Physik,* 98. 3–4. *pp.* 286–287, 1935.—The appearance of emission centres on cold kathodes is briefly described. These centres, which are submicroscopic, last for perhaps a minute, disappear and then reappear elsewhere; the number of emitting centres may be estimated, and from a knowledge of the total current density, it is possible to deduce the current density of a single emitting source. The results are to appear later.
H. J. H. S.

1384. Positive Ionic Current at the Glowing Kathode of a Gas Discharge Tube. M. J. Druyvesteyn. *Phys. Zeits. d. Sowjetunion,* 8. 5. *pp.* 579–583, 1935. *In German.*—Referring to Gvosdover's paper on the relation between ionic and electronic current from a hot kathode in Hg vapour [see Abstract 4033 (1935)] the author considers that allowance has not been made for the fact that the ionic current from the hot kathode will be greater than that from the cold. A modified method of calculation is given. **S. Gvosdover** replies that the ratio between the currents from hot and cold kathode has been taken into account. He considers that while Druyvesteyn's method of calculation is suitable in some cases it will not in general hold good.
J. J. S.

***1385. Conductivity of Flames Containing Alkali Metals. W. Kisselmann and A. Becker.** *Ann. d. Physik,* 25. 1. *pp.* 49–73, *Jan.,* 1936.—The conductivity of flames containing alkali metals is systematically studied over the temperature range 1250–1950° Abs. Considerably greater accuracy is claimed than that of previous experiments on account of the precision with which the experimental conditions can be reproduced. Details of the apparatus and procedure are included. It is found that the temperature variation of pure (metal free) flames agrees with theoretical predictions under certain specified conditions, and that the conductivity of the flame containing metal vapour appears to be proportional to the square root of the total metal content, at least for relatively small concentrations of metal. The temperature variation of the conductivity of the alkali flame is almost independent of the concentration of the metal in the region studied, *i.e.*, concentration of the atomised solution $0{\cdot}00001$–$0{\cdot}01N$. The relation between conductivity and flame temperature is investigated in detail for all the alkali metals and the observations show that the higher the temperature of the flame the more complete is the dissociation into free metal atoms. [See also Abstract 2567 (1932).]
R. L.

THERMOELECTRICITY.

See Abstract 1314.